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H. B. Fuqua

BULLETIN of the American Association of Petroleum Geologists

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of the

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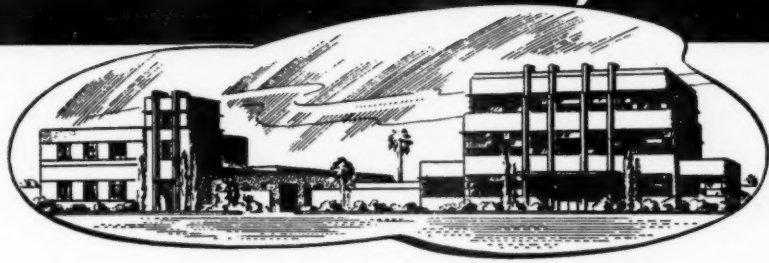
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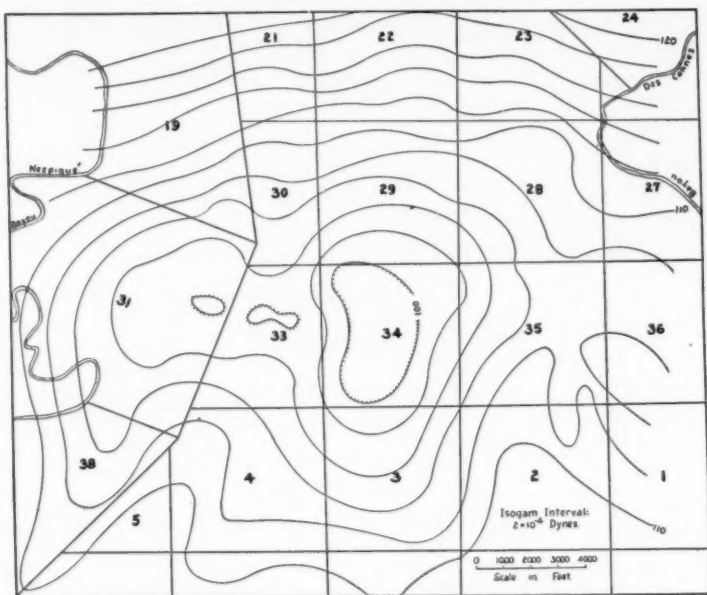
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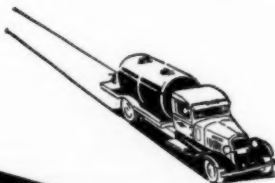
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BULLETIN
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**AMERICAN ASSOCIATION OF
PETROLEUM GEOLOGISTS**

MAY, 1938

**FUTURE OF THE GEOLOGIST IN THE
PETROLEUM INDUSTRY¹**

H. B. FUQUA²
Fort Worth, Texas

ABSTRACT

During the 1929-1932 depression the geological profession suffered greatly through loss of employment. An effort is made to point out various fields of cooperative endeavor wherein the geologist is well qualified to function and, through proper development of which, the profession should be enabled to avoid a repetition of the serious loss of employment which occurred at that time. The problems of the expert witness and of the professional appraiser are discussed briefly.

Article II of the constitution of the American Association of Petroleum Geologists is as follows.

The object of this Association is to promote the science of geology, especially as it relates to petroleum and natural gas; to promote the technology of petroleum and natural gas and to encourage improvements in the methods of exploring for and exploiting these substances; to foster the spirit of scientific research amongst its members; to disseminate facts relating to the geology and technology of petroleum and natural gas; to maintain a high standard of professional conduct on the part of its members; and to protect the public from the work of inadequately trained and unscrupulous persons posing as petroleum geologists.

How well the Association has fulfilled the several mandates set forth in that article is recorded in the hundreds of constructive manuscripts penned by its members which to a marked degree have promoted the science of petroleum geology, the technology of petroleum and natural gas, and the several other worthy scientific objectives set out therein. A year-to-year perusal of the Association's literature

¹ Presidential address read before the Association at New Orleans, March 16, 1938. Manuscript received, March 9, 1938.

² Geologist, The Gulf Oil Corporation.

in conjunction with a history of the petroleum industry will clearly show that our theories of "to-day" become the platitudes of the industry's "to-morrow." The much criticized anticlinal theory of White is now the basis of executive thought. The gas associated with an oil field, not long since considered by practical oil men as a necessary evil associated with the production of oil, is now looked on as one of the principal factors if not the deciding factor in the ultimate recovery from a field. Our literature is filled with theoretical and practical discussions on this subject. A decade ago it was only through most strenuous efforts that operators could be persuaded to save drill cuttings. To-day it is as much a part of drilling routine as is the actual drilling of the well itself. Who will hazard a guess as to what the ultimate recovery of Smackover, of Cushing, or of Hendrick, might have been had the geologist's theories on conservation of gas energy and control of water drive been accepted and practiced during their development? These examples could be multiplied ten fold. Each is the story of a theory of "to-day," accepted a day too late.

However, that they have been accepted finally and put into daily practice is due to the tireless labor of an association of earnest scientists and to *salesmanship*. The principal labor of developing the original theories of the science of petroleum geology has fallen to those of the Association's membership who may be designated as "pure scientists." They have been associated with federal and state surveys, with universities, and with research departments of various large corporations. The equally important and difficult task of finding practical application for these theories and, when found, of selling them to the practical men of the industry, has fallen to the lot of those who, through the nature of their business connections, necessarily must give more thought to the economic aspects of their profession. Due to changing conditions in the oil industry, it is becoming increasingly necessary to place more and more stress on drilling and producing procedure. In the future a considerable part of the profits from the industry is going to be made by utilizing more scientific and efficient methods of production. Because of the scientific information concerning subsurface conditions which active field and office geologists possess, they are in a strategic position to render a valuable service to, and at the same time enhance the profits of, the industry. It is primarily to this class of our membership that the following remarks are addressed.

The average petroleum geologist of this class recognizes correctly as his primary functions the study of earth history and the discovery of commercial deposits of oil and gas. However, it is a fact that this

represents only a minor part of the services which, by training and experience, he can and should contribute to the petroleum industry.

The present so-called "recession" which can very easily develop into another serious depression suggests urgently that the geologist take inventory of what he has to offer in the way of subsidiary services in order to avoid a repetition of the serious unemployment which shattered our ranks in the recent economic hiatus of 1929-1933. And having made this survey, a real problem of education and salesmanship confronts those among us who exert more or less influence in the industry. It has been the general experience of those who have been engaged in corporate work that the average executive, trained in business administration and leadership rather than in the infinite details of science, will welcome proffered assistance and, in a majority of cases, will furnish necessary personnel to carry out the functions discussed below. Before entering into this discussion, apology is made for covering certain points which appear elementary; but observation has shown that many of the most elementary functions of our profession are not properly utilized in certain corporate set-ups.

The chief supplementary services available through geological coöperation are as follows: (1) coöperation with the executive department, (2) coöperation with the production department, (3) coöperation in geophysical work, (4) coöperation in legal problems.

COÖPERATION WITH THE EXECUTIVE DEPARTMENT

Coöperation with the executive department as discussed herein refers, not to the contacts which normally exist between the departments, but to the many minor details of a technical or semi-technical nature which daily harass the busy executives and which, in the nature of his routine, he is unable properly to digest. More or less scientific articles in trade journals, perhaps covering in minute detail some subject in which he may have only a cursory interest, are noted by him or called to his attention. Time will not permit his studying the matter in detail, but he would in all probability welcome a one-page digest of the salient points of the article. Innumerable matters of a geological nature can be called to his attention either by memorandum or in conference—the stratigraphic location and character of newly discovered "pays"; the probable causes of unexpected well failures; geological or geophysical activities of competitors; geological explanations of well phenomena which may not be readily understood by minds not technically trained—these and many other matters of a similar nature, properly discussed, may lead to executive

appreciation and to a receptive attitude toward increased personnel to maintain and improve the type of service rendered.

COÖPERATION WITH THE PRODUCTION DEPARTMENT

Of all the fields open to coöperative effort by the petroleum geologist, the drilling of wells and the production of oil—that phase of the corporate body usually referred to as the production department—is, in all probability, most seriously neglected. Here the personnel is, by training and experience, capable of handling the mechanical, practical, and economic details of drilling wells and of producing the oil or gas. It is not to their discredit to state that they are not entirely qualified to interpret geological structure, to forecast and to recognize gas-oil and oil-water contacts, and to appreciate and understand the significance of the microscopic details of well cuttings and cores. It is to their discredit only when they fail to recognize the need, or to accept the coöperation of the trained geological personnel available to assist them. Where coöperation has been or can be established, the following recommendations and suggestions are among the many which should be made from time to time.

1. *The proper casing procedure to employ in order to protect potential shallow-water supplies for commercial and domestic use.*
2. *The proper casing procedure to insure against gas blowouts with their consequent hazard, expense, and physical waste.*
3. *The proper seating of the oil string in order to exclude all upper waters and any free gas which may be present above the oil "pay."*
4. *The proper cementing procedure to protect upper "pays" when the well is completed in a multiple-sand oil field.*
5. *The analysis of waters in order to determine their source and suggestions as to their possible elimination.*
6. *The interpretation of Schlumberger surveys in the light of geological knowledge.*
7. *The depth to which wells may be drilled in order to penetrate a maximum of the pay section with minimum danger of encountering water. This subject requires much study of the field or area as a whole by men trained to understand and interpret structure and stratigraphy.*

The subject of oil-field waters, their study, their utilization, their analysis and their control is one so broad in its ramifications that it is worthy of treatment in a symposium; and the encouragement of symposium treatment should be given serious consideration by the Association.

8. *Scientific determination and recommendations about the method*

of artificial stimulation best adapted to wells where such procedure is necessary. Shooting with nitroglycerine, though expensive, is generally accepted as being the most efficient. In the case of limestone and dolomite "pays" treatment with hydrochloric acid usually produces excellent results per dollar invested. However, there are cases on record where such treatment has actually damaged rather than increased the productive capacity of wells, due, in all probability, to the amount of insoluble materials present in the host rock, which, when driven back into the formation under pressure, tend to clog the pore space. It is the function of the geologist, through a study of samples or cores, to protect the operator against such occurrences. In late stages of recovery, excellent results are obtained in some fields by water flooding or by gas or air injection and, again, the geologist with a detailed knowledge of conditions within the pay zone can be of material assistance in working out the proper program.

9. *A detailed study of old producing wells or fields before abandonment.* Obviously no well should be abandoned until the geological department has had an opportunity to determine the advisability of drilling to deeper "pays" or of testing any shallower "pays" which might have been cased off at original completion.

COÖPERATION IN GEOPHYSICAL WORK

The science of geophysics has assumed a definite place in the exploratory field of the petroleum industry. Supplementing the work of the geologist and under his direction the geophysicist has performed a great service, the value of which is generally understood and appreciated. However, as is usual in a highly competitive industry such as ours, the relatively simple provinces have received first attention. Far more complicated problems face the geophysicist in the future than have been solved in the past. More and more will he have to depend on geological data and interpretation to keep him on the proper track. The basement complex, major unconformities, overlaps, the physical changes which occur in highly gradational areas, the nature of surface weathering—these and many other factors which weigh heavily in the geophysicist's calculations are available through the coöperation of the geologist. Here is a field open to geologists of the highest type, with a broad knowledge of the tectonic and sedimentary history of the area being explored. It is no place for the novice.

COÖPERATION IN LEGAL PROBLEMS

Due to the spread of the conservation movement with its consequent laws, hearings, and rulings, the legal profession has been called

on to an increasing degree in order to interpret such laws and rulings and to secure equitable treatment for those whom it represents. These laws and rulings of man have now developed to a point where they encroach definitely on the laws of nature. The result is that the legal profession which interprets the laws of man is dependent on the geologist and the engineer for an interpretation of the laws of nature and *vice versa*. Their several functions are obvious and need no comment.

There is, however, a matter of serious moment which should be called to the attention of this Association. Certain of its members apparently, through a misguided conception of their duty to their employers, are failing to recognize accepted facts when appearing as expert witnesses or neglecting to properly advise their client or employer as to the limit to which they can go in testimony without dishonor to themselves or their profession. There are cases on record by our members that would, in the judgment of the writer, subject them to expulsion under our constitution. It should be borne in mind that technical men in our profession advance to a considerable degree upon the reputation for integrity which they build; and since the reputation of the Association is dependent upon that of its membership, this problem should be given serious consideration by those who guide its destiny.

ESTIMATION OF RESERVES

There is one more point, perhaps irrelevant to the theme of this paper, but, nevertheless, directly relating to the welfare of the Association and its members. This is the matter of the estimation of oil and gas reserves. Estimates on identical properties by different appraisers may vary from ultra conservative to liberal, and it is worthy of note that the degree of conservatism is usually a direct function of the status of the client—whether buyer or seller, borrower or lender.

No criticism is intended as to the ethics of such estimates. Any estimate is at best a hazardous guess, subject to many uncertain factors and to a wide—but not too wide—divergence of opinion; and the appraisers are merely protecting their clients to the best of their ability against these hazards and uncertainties. The conservative estimate represents a good purchase for the buying client and the selling client would be wise in disposing of property on an optimistic one, thus shifting the hazards involved to other hands.

There is, however, another factor to be considered. The great rank and file of the oil fraternity are forced to depend on outside appraisals in the daily pursuit of their business; and when these

apparently inconsistent estimates, not properly clarified, come to their attention, they are inclined to lose confidence in the profession responsible for them. Serious consideration should be given by members engaged in such work to the idea of protecting their clients in some other manner than by applying hidden discounts to the basic reserve figure. Surely the same result can be obtained by submitting an estimate in line with the facts and recommending the proper adjustment which should be applied to this figure to protect the interest of the client.

CONCLUSION

There are no doubt other fields of endeavor wherein our profession may find room to expand. However, these suggestions offer at least a working basis for constructive thought. We have reached a new peak in membership, in output of manuscript, and, it is sincerely believed, in technique and ability. Whether or not we shall reach greater peaks during the coming years is dependent on the membership itself, on the ability of the members to give better and better service along old established lines and to convince the industry that they are needed—and much needed—in certain supplementary lines of endeavor, the potentialities of which have, as yet, been barely scratched.

NEWLY DISCOVERED SECTION OF TRINITY AGE IN SOUTHWESTERN NEW MEXICO¹

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ABSTRACT

Lower Cretaceous rocks newly discovered in the Little Hatchet Mountains in southwestern New Mexico display an exposed thickness ranging from 17,000 to 21,000 feet. The base of the section is covered by valley fill and the top by Tertiary volcanics. The entire exposed section seems to be of Trinity age, and more than 15,000 feet of it is of Glen Rose or upper Trinity age. The section is noteworthy also (1) for the presence of three disconformities that indicate the removal of thicknesses of rock measurable in thousands of feet, (2) for a high proportion of conglomerate, mostly intraformational, (3) for a repetition of zones of similar lithology and fauna, four-fold with respect to some zones, and (4) for a great thickness of basaltic volcanic rocks. The section has been divided into seven formational units to which local names have been given; these are, in ascending order, the Broken Jug limestone, the Ringbone shale, the Hidalgo volcanics, the Howells Ridge formation, the Corbett sandstone, the Playas Peak formation, and the Skunk Ranch conglomerate.

The more significant fossils thus far identified include *Douvilleiceras*, *Beudanticeras*, *Exogyra quitmanensis*, a large *Pecten* that is characteristic of Taff's "Quitman bed," and *Orbitolina*. The formations as a group are equivalent in age to part of the Bisbee group of Arizona, but specific correlation of individual formations with members of the Bisbee group is not possible. Some of the formations in the Little Hatchet Mountains apparently, however, can be correlated with exposures in the neighboring ranges.

With the exception of those of volcanic origin, the rocks are beach and shallow-water deposits, including some fresh-water beds. They were deposited in a rapidly subsiding basin of geosynclinal dimensions whose shore line was generally near and at times within what is now the north half of the Little Hatchet Mountains, the shore line shifting back and forth over a strip perhaps 10-20 miles wide. The center of volcanism from which the volcanic rocks were derived seems to have been near the edge of the basin and somewhat on the landward side.

INTRODUCTION

The purpose of this paper is to call attention to a newly discovered section of Lower Cretaceous rocks in southwestern New Mexico, an extension of part of the Comanche section of Texas and Mexico. The section is extremely thick, and although it contains only rocks of Trinity age—and largely of Glen Rose or upper Trinity age—is nevertheless thicker than any full Comanche section thus far described;³ in fact, the beds of Glen Rose age, which form a continuous

¹ Published by permission of the directors of the Federal Geological Survey and the New Mexico Bureau of Mines and Mineral Resources. Manuscript received, January 19, 1938.

² United States Geological Survey.

³ L. B. Kellum, "Paleogeography of Parts of the Border Province of Mexico Adjacent to West Texas," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 20 (1936), pp. 417-32.

exposed section considerably more than 15,000 feet in thickness, are thicker than the reported total of the Texas Cretaceous.⁴

The section was discovered in 1934 during a survey of the Little Hatchet Mountains, which were examined, under a cooperative agreement between the Federal Geological Survey and the New Mexico Bureau of Mines and Mineral Resources, as part of a broader survey of the whole of Hidalgo County. A general report on the geology and ore deposits of the Little Hatchet Mountains, including a more complete description of the Lower Cretaceous rocks than appears here, is in preparation and will be published by the Geological Survey.

The only information hitherto available concerning the stratigraphy of the Little Hatchet Mountains was furnished by the reconnaissance descriptions of Lindgren, Hill, and Darton. Lindgren visited the area in 1905, and Hill in 1909, both in connection with a reconnaissance survey of the ore deposits of New Mexico.⁵ They classified a large part of the sedimentary section as of Paleozoic age but thought that some of the rocks might be Cretaceous. Darton visited the range about 1920 and confirmed Lindgren's and Hill's belief that some of the rocks might be Cretaceous by finding a few Lower Cretaceous fossils, but he ascribed most of the sedimentary rocks to the Magdalena group of Pennsylvanian age.⁶ He believed that the Lower Cretaceous rocks represented both the Trinity and Washita groups, indicating them on his map⁷ as "Sarten sandstone and underlying limestone."

ACKNOWLEDGMENTS

The writer has discussed the stratigraphy of the Little Hatchet Mountains with a number of persons and wishes to thank them for their consideration. The writer is particularly indebted to C. E. Needham and A. Andreas of the New Mexico Bureau of Mines, and to J. B. Reeside, Jr., and James Gilluly of the Geological Survey. Most helpful of all were field conferences with Reeside and Gilluly, which directed the writer's attention to some field facts that had been overlooked and that made him aware of the meaning of others. T. W. Stanton and Gayle Scott have examined fossils from the area.

⁴ E. H. Sellards, W. S. Adkins, and F. B. Plummer, "The Geology of Texas," *Univ. Texas Bull.* 3232 (1932), Vol. 1, p. 260.

⁵ Waldemar Lindgren, L. C. Graton, and C. H. Gordon, "The Ore Deposits of New Mexico," *U. S. Geol. Survey Prof. Paper* 68 (1910), pp. 335-43.

⁶ N. H. Darton, "Red beds and Associated Formations in New Mexico," *U. S. Geol. Survey Bull.* 794 (1928), pp. 346-47.

⁷ N. H. Darton, *U. S. Geol. Survey Geologic Map of New Mexico* (1928). (Scale 1:500,000.)



FIG. 1.—Map of southwestern New Mexico and adjacent parts of Arizona and Mexico, showing location of Little Hatchet Mountains (shaded area). *H*, Hachita Quadrangle; *P*, Playas Quadrangle; *BH*, Big Hatchet Peak Quadrangle; *L*, Lordsburg Quadrangle.

GENERAL GEOLOGY

The Little Hatchet Mountains cover about 75 square miles west of the town of Hachita in southwestern New Mexico and occupy parts of the Hachita, Playas, and Big Hatchet Peak quadrangles (Fig. 1). They are one of the northward-trending desert ranges that characterize that part of the country.

With the exception of a small isolated exposure of uncertain correlation (Fig. 2), all the exposed sedimentary rocks appear to be of Trinity age. They are intruded by sills and stocks of late Cretaceous or early Tertiary age and are overlain unconformably by Miocene (?) tuffs, breccias, and flows. The Trinity formations in the north half of the range have been folded into a broad anticline whose axis trends northwest through the northeastern foothills near the Ringbone Ranch, and into a companion syncline whose axis trends north of west through Howells Wells, near the center of the range; and those in the south half have been tilted into a monocline that, before faulting, appears to have been the south limb of a second anticline. Two great faults cross the range and several smaller ones are present, but the effects of all are readily apparent.

The rocks of Trinity age in the Little Hatchet Mountains are remarkable for several features: (1) the extraordinary thickness of the section, averaging approximately 19,000 feet; (2) the fact that more than 15,000 feet of it is of Glen Rose age; (3) the presence of contemporaneous basaltic volcanic rocks, one continuous section of which is more than 5,000 feet thick; (4) the presence of several deep disconformities,^a one of which indicates the removal locally of a measurable thickness of as much as 1,500 feet of beds, one perhaps more than 2,000 feet, and another more than 5,000 feet; (5) a high proportion of conglomerate, mostly intraformational; and (6) a repetition, four-fold in some examples, of zones of similar lithologic character and fauna.

The section has been divided into seven formations whose limits have been placed as consistently as possible at disconformities or at horizons of prominent lithologic change, each formation representing a particular set of depositional conditions. Five disconformities have been recognized, but only one is continuous throughout the area. In a general way, except for that one, all contacts are disconformable in the north half of the range and conformable in the south half. The formations include, in ascending order, the Broken Jug limestone, the Ringbone shale, the Hidalgo volcanics, the Howells Ridge forma-

^a As used in this paper, the term disconformity signifies an unconformity in which the beds above the erosion surface are parallel with those below.

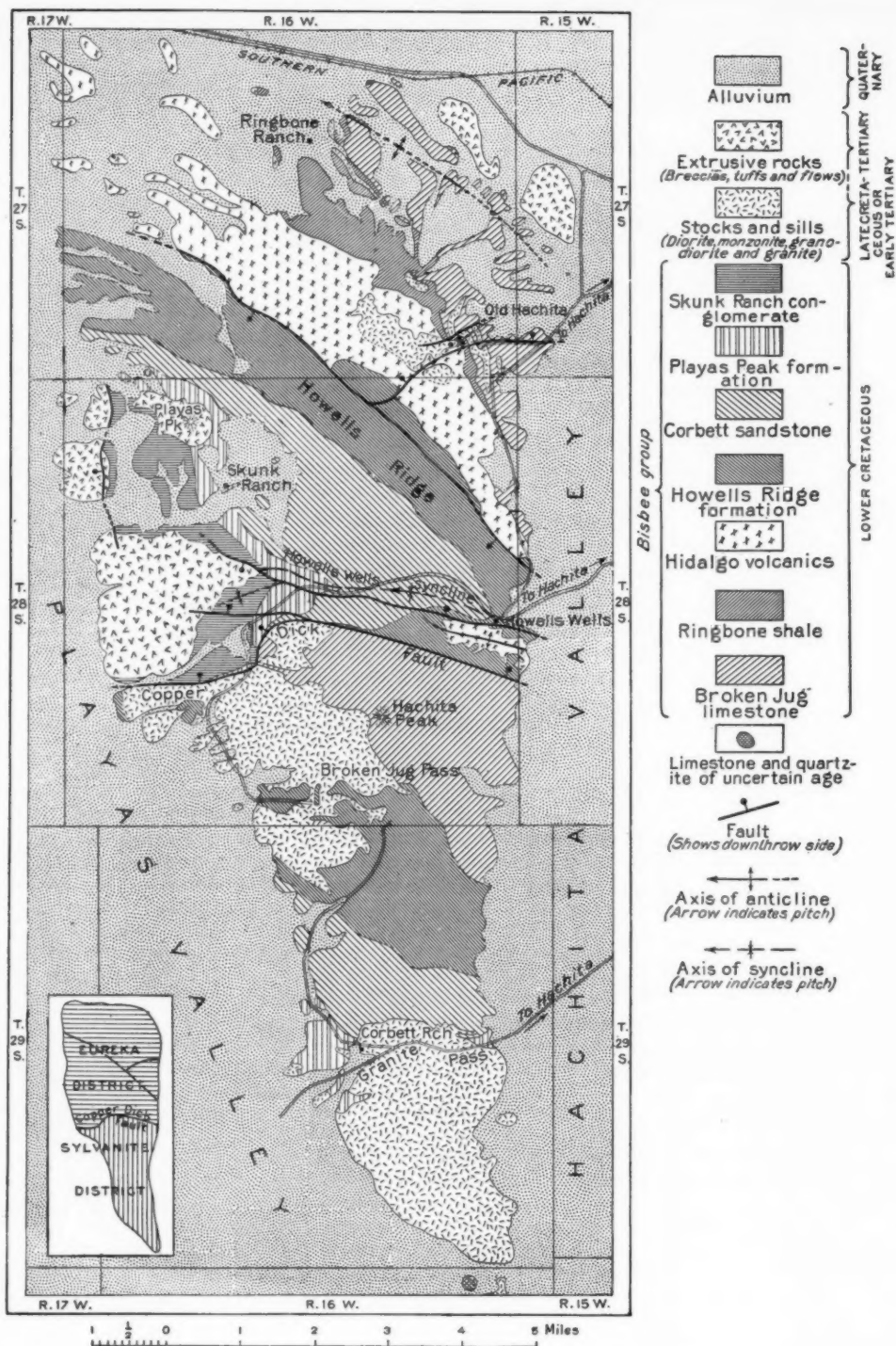


FIG. 2.—Simplified geologic map of Little Hatched Mountains, New Mexico.

tion, the Corbett sandstone, the Playas Peak formation, and the Skunk Ranch conglomerate (Fig. 3). All these names are here applied for the first time. The distribution of the several formations is shown in Figure 2, which has been somewhat simplified from the larger scale field map so that the general relations will not be obscured.

With the exception of the Ringbone shale, Hidalgo volcanics, and Skunk Ranch conglomerate, the same sequence of formations crops out in the southern part of the range as in the northern part, the formations being duplicated by the Copper Dick fault (Fig. 2). The Hidalgo volcanics are absent from the southern part of the range because of one of the disconformities; the Ringbone shale is absent because it was deposited in a body of fresh water that did not extend

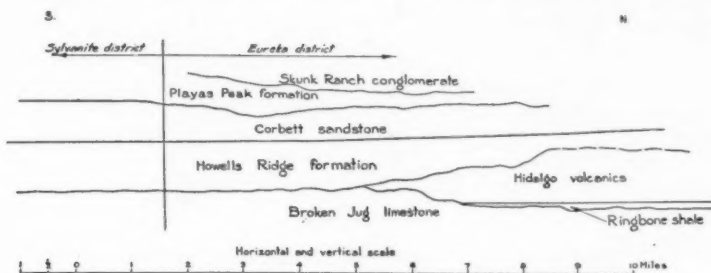


FIG. 3.—General stratigraphic relations of formations in Little Hatchet Mountains, New Mexico.

toward the south; and the Skunk Ranch conglomerate, or its offshore equivalent, is absent because it has been cut out by one of the stocks. The Howells Ridge formation in the northern part of the range contains a minor volcanic member that is absent in the southern part, but otherwise the lithologic details of the individual formations in the two parts are respectively similar. Figure 4 shows the comparative stratigraphy of the two areas, the northern known as the Eureka section of the range and the southern as the Sylvanite section, after the corresponding mining districts.

The total thickness exposed in the Sylvanite section is between 15,300 and 15,800 feet. The total thickness exposed in the Eureka section ranges from 12,700 feet, obtained by adding minimums, to 24,150 feet, obtained by adding maximums; the actual thickness present in a continuous section in the Eureka area, however, is from 17,000 to 21,000 feet, the maximum thicknesses of some formations overlying the minimum of others (Fig. 3).

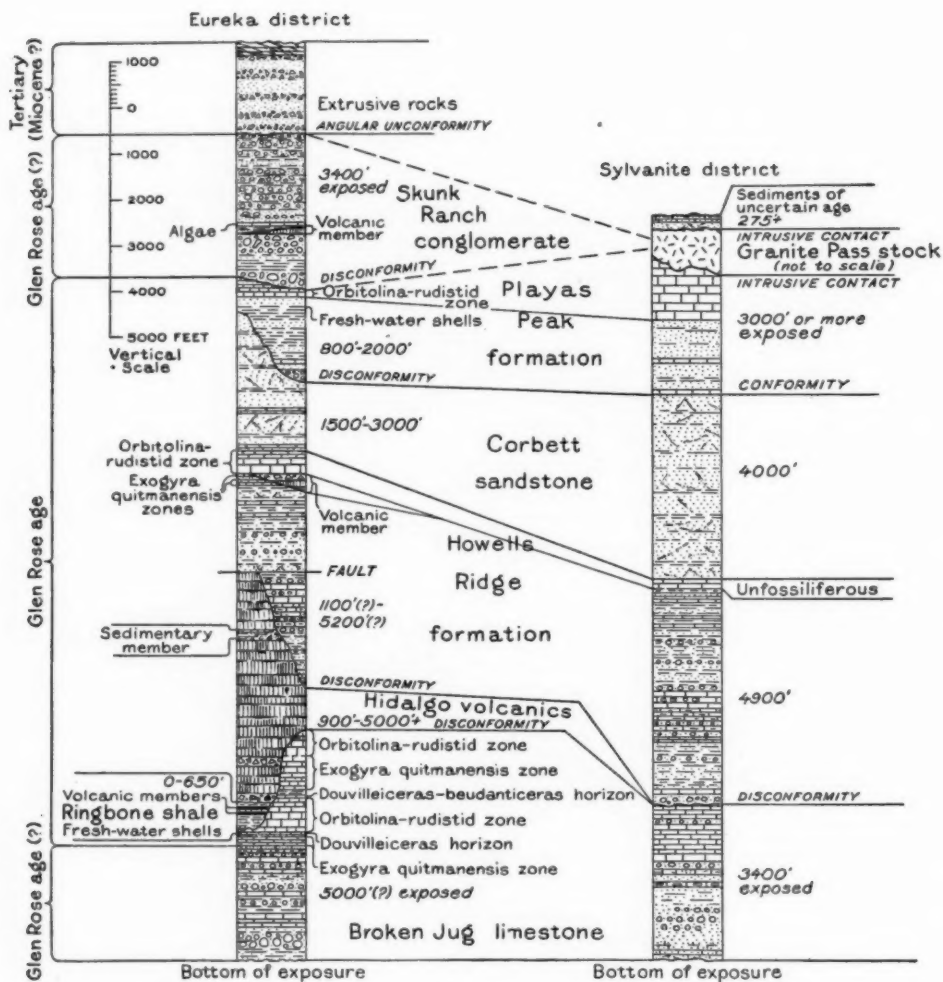


FIG. 4.—Comparative stratigraphic columns in Eureka and Sylvanite sections of Little Hatchet Mountains, New Mexico. Thicknesses of formations and of principal members are drawn to scale, with exception of stock, as noted; other details of stratigraphy are generalized.

DESCRIPTION OF FORMATIONS

Broken Jug limestone.—The Broken Jug limestone is named from Broken Jug Pass in the Sylvanite part of the range, where the formation occupies several square miles on the east side of the crest. It is cut off on the north by the Copper Dick fault and on the west by one of the stocks. Its resistant metamorphosed parts next to the stock have preserved Hachita Peak. In the Eureka district, the Broken Jug formation makes up the dissected chain of hills and ridges that front the northeast corner of the range.

The composition of the Broken Jug limestone is highly variable in detail, but in general the formation consists of limestone, pure, shaly, and sandy, interbedded with sandstone, shale, and conglomerate. Coarse limestone conglomerate is prominent locally, and fragments of crinoid stems were observed in pebbles in the lowermost part of the section. Red to green shale and sandstone are present at three horizons in the Eureka district. In its central part, the Eureka part of the formation contains an extensive coquina zone 190 feet thick composed of *Exogyra* beds 2–10 feet in thickness separated by less fossiliferous layers. Above the *Exogyra* zone are several hundred feet of limestone, thin-bedded and ammonite-bearing near the base, massive and *Orbitolina*-bearing above. The *Orbitolina*-bearing beds thin within a short distance northward beyond Old Hachita to as little as 60 feet and then merge into a great thickness of conglomerate cemented locally by masses of *Orbitolina* limestone. A second *Exogyra* zone, a second ammonite zone, and a second *Orbitolina* zone crop out in the two isolated exposures about 1½ miles north of Howells Wells (Fig. 2).

The full thickness of the Broken Jug limestone is not known, for the base of the formation is hidden beneath the valley fill. The exposed thickness, which is variable because of the disconformity at the top, reaches approximately 3,400 feet in the Sylvanite district and perhaps more than 5,000 feet in the Eureka district; the thickness in the Eureka district is uncertain primarily because of the isolated position of the second *Exogyra*, ammonite, and *Orbitolina* zones mentioned in the foregoing paragraph. The Broken Jug limestone is overlain in the Eureka district by the Ringbone shale, in part conformably, in part disconformably, and by the Hidalgo volcanics beyond the limits of the Ringbone shale. In the Sylvanite district it is overlain directly by the Howells Ridge formation.

Ringbone shale.—The Ringbone shale is named from the Ringbone Ranch, near which the formation is best exposed. In that vicinity the Ringbone shale is interfingering with the conglomerate of the under-

lying Broken Jug limestone, but toward the southeast, at a point about a mile northwest of Old Hachita, the contact becomes disconformable and the Ringbone shale gradually thins out southward against the old surface of the Broken Jug limestone.

A basal conglomerate, containing boulders as large as 2½ feet in diameter, partly fills the hollows of the old erosion surface. The pebbles and boulders consist of sandstone, earlier conglomerate, fossiliferous limestone, and coquina, all of which could have been derived from the Broken Jug limestone below. Above the conglomerate most of the formation consists of dark shale, subordinate sandstone, and here and there a bed of black limestone. The thickness of any single bed rarely exceeds 5 feet. The upper 150 feet is composed of tuffaceous sandstone and shale containing two purer volcanic members, one a basalt flow and one an andesite breccia, each approximately 50 feet thick.

The maximum thickness of the Ringbone shale is about 650 feet. Some evidence of channeling can be recognized at the top, but the amount of material removed before deposition of the Hidalgo volcanics seems to have been small.

Fossils are scarce, but some fresh-water shells have been collected. Fossil wood, some of it in the form of large logs, is common at one horizon.

Hidalgo volcanics.—The Hidalgo volcanics are named from Hidalgo County, over which the formation seems to be widely distributed. It was first studied in the Lordsburg mining district,⁹ but was not named (see paragraphs on "Age and Correlation"). The formation consists primarily of basaltic lava flows. Breccia is common at the base in the Little Hatchet Mountains, and a little pyroclastic material is present at other horizons. Volcanic activity was interrupted at one stage long enough for approximately 200 feet of sediments to be deposited locally. The sediments consist of thin-bedded light gray and red limestone, red and green shale, and some conglomeratic layers. At one place they merge laterally into roughly sorted tuff and fine breccia.

The stratigraphic relation of the Hidalgo volcanics to the other formations is shown in Figure 3. The total thickness of the formation is not known, for the topmost part has been dropped from view by a fault that has cut out part of the contact between the volcanics and the Howells Ridge formation (Fig. 2). The exposed thickness ranges from 900 to 5,000 feet, the wide range being due to the disconformities at top and bottom.

⁹ S. G. Lasky, "Geology and Ore Deposits of the Lordsburg Mining District, Hidalgo County, New Mexico," *U. S. Geol. Survey Bull.* 885 (1937), pp. 9-14.

Howells Ridge formation.—The Howells Ridge formation is named from a high cliff-capped ridge in the Eureka section that is composed entirely of rocks of this formation.

The lower part consists commonly of red beds of mudstone, shale, limestone, sandstone, and conglomerate, though in parts of the Eureka section the beds are gray to black. A notable feature of the lower part of the formation as a whole is the transition along the strike from one kind of rock to another within very short distances. Two coquina-like *Exogyra* zones crop out in this part on the north side of Howells Ridge north of Howells Wells.

The topmost part of the formation in the Eureka section consists of massive and thin-bedded black limestone and massive crystalline creamy white limestone, all fossiliferous, and particularly *Orbitolina*-bearing. These beds form the cliffs of Howells Ridge. Locally below the cliff-making limestone, the formation contains a layer of andesite flows and breccia whose thinner parts grade into purple shaly mudstone and arkosic volcanic grit. In the Sylvanite part of the formation the limestone at the top is much thinner than in the Eureka part and is unfossiliferous (Fig. 4).

The thickness of the Howells Ridge formation is approximately 4,900 feet in the Sylvanite section. In the Eureka section it is indeterminate because nowhere is the full original thickness exposed—it may range from 1,100 feet to 5,200 feet, but neither figure is reliable.

Corbett sandstone.—The Corbett sandstone, named from the Corbett Ranch at Granite Pass, lies conformably on the Howells Ridge formation, the contact being chosen at the break between the limestones at the top of the Howells Ridge formation and the essentially continuous sandstone section of the Corbett. The transition is fairly sharp in the Sylvanite district but locally it includes a zone approximately 50 feet thick in the Eureka district.

The formation consists chiefly of sandstone, in part quartzitic and massive, and variably black, brown, and white in color. Ripple marks and cross-bedding are common, and some beds show a marked range in coarseness in thin laminations. In part the formation contains beds of shale that alternate with the sand and range from 1 to 15 feet in thickness, and in the eastern part of the Eureka section it includes several limestone members that contain a marine pelecypod and gastropod fauna.

The thickness of the Corbett sandstone is 4,000 feet in the Sylvanite section, where the full original thickness is present, and ranges from 1,500 to 3,000 feet in the Eureka section, where part of the for-

mation has been removed by erosion as evidenced by the disconformity at the top.

Playas Peak formation.—The Playas Peak formation is named after Playas Peak in the Eureka half of the range. It consists of sandstone and shale underlain in the Eureka section by a basal conglomerate and capped by massive *Orbitolina*-bearing limestones. The basal conglomerate contains only Lower Cretaceous rocks and is locally bouldery and unsorted. Fresh-water shells and fragments of fossil wood have been collected from the sandstone-shale part of the Eureka section.

The thickness of the Playas Peak formation in the Eureka section, where both contacts are disconformable, ranges from 800 to 2,000 feet, but in the Sylvanite section the exposed thickness is between 3,000 and 3,500 feet, the topmost part being cut out by one of the stocks or covered by alluvium. The actual exposed thickness of the Sylvanite section is uncertain because the *Orbitolina*-bearing limestone at the top is in part a flow-distorted marble whose original thickness may have been somewhat different from the present thickness.

Skunk Ranch conglomerate.—The Skunk Ranch conglomerate crops out only west and south of the Skunk Ranch in the Eureka section. It consists largely of coarse conglomerate composed of red boulders and pebbles of various rocks in a matrix of red sandstone and shale. Boulders and slabs as much as 20 inches across are comparatively common, and the average diameter seems to be about 4 inches. Lateral gradations from the red bouldery conglomerate to gray and finer-grained limestone conglomerate and to coarse-grained sandstone are exposed here and there. Layers of yellow clay-shale and soft sandstone are present at several horizons, and a large part of the upper half of the formation consists of alternating beds of red clay-shale and massive red conglomerate in members 5-60 feet in thickness. The boulders and pebbles in the lower half of the exposed section include older conglomerates, limestone containing Trinity fossils, sandstone, fossil wood, and basalt, all rocks that could have been derived from the beds of Glen Rose age below. In the upper half, in the thick section of alternating red clay-shale and red conglomerate, a great number of the limestone boulders contain Paleozoic fossils of apparently Pennsylvanian and Permian (?) ages. A 200-foot layer of augite basalt is exposed at one place.

The maximum exposed thickness of the Skunk Ranch conglomerate is 3,400 feet, the topmost part of the formation being covered by the Miocene (?) volcanic rocks.

AGE AND CORRELATION

Some of the fossils collected from the Little Hatchet Mountains have been identified by T. W. Stanton and J. B. Reeside, Jr., and other collections are being studied. All will be listed in the full report on the Little Hatchet Mountains, and several ammonites included in the list will be described by Gayle Scott in a forthcoming paper on Trinity ammonites.

The general faunal assemblage is much the same throughout the sequence, but with a repetition of particular forms at several horizons, accompanied by a repetition of zones of similar or identical lithology. There are four zones of massive limestone, perhaps of reef origin, containing many specimens of the foraminifer *Orbitolina*, the mollusks *Toucasia* and rudistids, and perhaps less commonly the large gastropod *Tylostoma*; four zones of coquina with *Exogyra quitmanensis* and a large *Pecten*; two horizons containing the ammonite *Douvilleiceras*; repeated but less distinct and less critical occurrences of the gastropod *Nerinea*; and two or three zones containing fresh-water mollusks and fossil wood. The stratigraphic distribution of the important zones is shown in Figure 4. The more significant fossils thus far identified include *Exogyra quitmanensis* Cragin, a large unnamed *Pecten* that Stanton says is characteristic of Taff's "Quitman bed,"¹⁰ *Orbitolina*, and the ammonite *Douvilleiceras*.¹¹ These are Trinity forms; the *Douvilleiceras* in this association apparently indicates lower Glen Rose age,¹² and Stanton reports that he has "no hesitation in referring the several lots containing *Orbitolina* to rocks of Glen Rose age." Consequently the entire section from the *Orbitolina* zone at the top of the Playas Peak formation to the lower *Orbitolina* zone of the Broken Jug limestone is of Glen Rose age, and the fact that the *Exogyra quitmanensis* zones are sandwiched between some of the *Orbitolina* zones suggests that the Glen Rose interval may extend at least down through the lower *Exogyra* beds of the Broken Jug limestone. As no special lithologic break is exposed below the lowest *Exogyra* beds, the basal beds also of the Broken Jug lime-

¹⁰ J. A. Taff, "The Cretaceous Deposits [of El Paso County, Texas]," *Texas Geol. Survey 2d Ann. Rept.* (1891), pp. 714-38.

¹¹ The multifold repetition of zones of similar lithology and fauna aroused the suspicion early in the field work that there had been structural repetition of the formations, but the idea was gradually discarded as mapping progressed. The formations are cleanly exposed, for vegetation and soil are sparse, and the attitude of the rocks can be measured at almost every point and the contacts can be observed practically foot by foot. This faunal and lithologic repetition is interpreted by T. W. Stanton as due to faulting. A similar opinion was held by J. B. Reeside, Jr., and James Gilluly, of the United States Geological Survey, but after they participated with the writer in a field conference they agreed that the repetition can not be attributed to structure.

¹² E. H. Sellards, W. S. Adkins, and F. B. Plummer, *op. cit.*, pp. 269-71, 294-95.

stone may be of Glen Rose age, and it is presumed that they are at least as young as Trinity.

The only fossils found in the Skunk Ranch conglomerate are some algal deposits that contribute no information at present for correlation, but the geologic history of the formation, as indicated by the disconformable base, by the general lithologic character, and by the volcanic layer, fits so well into the general history of deposition of the underlying beds that the Skunk Ranch conglomerate is assumed to belong to the same epoch.

The formations of the Little Hatchet Mountains as a group are equivalent in age to part of the Bisbee group¹³ of southeastern Arizona in that the Mural limestone of the Bisbee group is also of Trinity age, and the name Bisbee group is therefore used for the rocks of the Little Hatchet Mountains. A few places have thus far been found in the neighboring desert hills where formations of Trinity age can be correlated with specific formations in the Little Hatchet Mountains, but the repetition of zones of similar fauna and of similar lithology, the lateral changes in lithology shown by some of the formations, and the fact that neither the upper nor the lower limits of the Trinity interval are exposed, or at least not identifiable at present, make detailed correlations over a broader area an impossible task at the present time.

Darton¹⁴ stated that the Lower Cretaceous "limestones of the Hatchet Mountains region closely resemble the Mural limestone of the Bisbee and Douglas regions, Arizona, to which they are doubtless equivalent," but though both formations are of Trinity age the problem of correlation is more complicated. The Lower Cretaceous limestone that Darton¹⁵ recognized in the Little Hatchet Mountains is the cliff-making *Orbitolina*-bearing member at the top of the Howells Ridge formation, and although that member does indeed resemble the cliff-making *Orbitolina*-bearing Mural limestone, the other *Orbitolina*-bearing limestones in the Little Hatchet Mountains are lithologically and faunally essentially identical with the Howells Ridge *Orbitolina*-bearing member, and any one of them or, conceivably, none of them at all, could equally well be the equivalent of the Mural. Moreover, parts of the red-bed section of the Howells Ridge formation resemble both the Morita and Cintura formations of the Bisbee group, one below the Mural and one above it, and the reddish

¹³ F. L. Ransome, "Geology and Ore Deposits of the Bisbee Quadrangle, Arizona," *U. S. Geol. Survey Prof. Paper 21* (1904), pp. 56-73.

¹⁴ N. H. Darton, *op. cit.*, p. 38.

¹⁵ Oral communication.

beds at three horizons in the Broken Jug limestone also might be duplicated in the Morita and Cintura formations.

Darton¹⁶ says that what the writer calls the Corbett sandstone is the formation that was correlated with the Sarten sandstone in Darton's map unit "Sarten sandstone and underlying limestone."¹⁷ The Sarten sandstone, however, in its type locality on Sarten Ridge, north of Deming,¹⁸ contains fossils that Stanton¹⁹ referred to the Washita group, stating that they show about the same faunal facies found in the marginal deposits of southern Kansas and near Tucumcari, New Mexico; Adkins²⁰ compares them with the Kiamichi fauna, which he places in uppermost Fredericksburg.

The Lower Cretaceous volcanic rocks of the Little Hatchet Mountains have been traced beyond the limits of the range and found to be equivalent to the earlier volcanic rocks of the Lordsburg mining district²¹ at the north end of the Lordsburg Quadrangle (Fig. 1), and the writer has recognized them, in the course of brief visits, in the Apache Hills, 10 miles east of the Little Hatchet Mountains, and on the pediment between the Apache Hills and the Sierra Rica. The presence of volcanic rocks of similar character at several horizons in the Little Hatchet Mountains, however, prevents a more precise correlation at present, although the great thickness of the Lower Cretaceous volcanics in the Lordsburg district probably means that those rocks are the equivalent of the Hidalgo volcanics. The volcanic rocks of the Little Hatchet Mountains may be approximately equivalent also to some thin andesitic flows in the Courtland-Gleason region north of Bisbee, Arizona, in sediments that Wilson²² believes resemble the Lower Cretaceous beds of other parts of Arizona, but beyond this they can not be correlated with any other of the known pre-Tertiary volcanic rocks in the surrounding regions, because those rocks are Upper Cretaceous in age.²³ They probably can, however, be corre-

¹⁶ Oral communication.

¹⁷ N. H. Darton, *U. S. Geol. Survey Geologic Map of New Mexico* (1928).

¹⁸ N. H. Darton, "Geology and Underground Water of Luna County, New Mexico," *U. S. Geol. Survey Bull.* 618 (1916), pp. 43-44.

¹⁹ *Ibid.*

²⁰ E. H. Sellards *et al.*, *op. cit.*, p. 281.

²¹ S. G. Lasky, *op. cit.*

²² E. D. Wilson, "Geology and Ore Deposits of the Courtland-Gleason Region, Arizona," *Arizona Bur. Mines, Geol. Ser.* 5, Bull. 123 (1927), pp. 21-22.

²³ Sidney Paige, "Silver City, New Mexico," *U. S. Geol. Survey Geol. Atlas Folio 199* (1916), pp. 7, 12. C. P. Ross, "Geology and Ore Deposits of the Aravaipa and Stanley Mining Districts, Graham County, Arizona," *U. S. Geol. Survey Bull.* 763 (1925), pp. 25-28. N. L. Taliaferro, "An Occurrence of Upper Cretaceous Sediments in

lated with some andesitic volcanic rocks that crop out in Lower Cretaceous sediments near Sahuaripa, Sonora, Mexico, and perhaps also with similar volcanic rocks that crop out over an area of several thousand square miles in neighboring parts of Sonora and Chihuahua.²⁴

INTERPRETATIONS

The great thickness of Lower Cretaceous beds in the Little Hatchet Mountains indicates a depositional basin of geosynclinal dimensions, and the average rate of subsidence must have been exceptionally rapid to permit deposition of most of that thickness within Glen Rose time. The rate of erosion also must have been exceptionally rapid to yield the necessary amount of material and to permit the unconformities to cut so deeply. It is noteworthy that erosion cut into and removed Glen Rose rocks already sufficiently lithified to sustain a topography of great relief and to permit boulders to be broken off, rounded, and carried away without disintegration.

Several lines of evidence combine to indicate that the shore line of the basin of deposition was near and at times within what is now the Eureka section of the Little Hatchet Mountains, moving back and forth over a strip approximately 10-20 miles wide. The generally unconformable nature of the major contacts in the Eureka section as opposed to their generally conformable nature in the Sylvanite section indicates that each major retreat of the sea was accompanied by a marked rise of the north part of the basin, which apparently was pivoted along a line somewhere between the Eureka and Sylvanite sections, the south or Sylvanite section of the basin remaining consistently under water, except for the Hidalgo and Ringbone intervals, while the north or Eureka section was alternately flooded and exposed to erosion. Perhaps the unconformities were in part produced by submarine erosion, but in general the average position of the southern limit of the shifting shore line was presumably near the pivot axis, in the vicinity of the dividing line indicated in Figure 3. During the time when the Hidalgo volcanics were being eroded from the Sylvanite part of the basin, the shore line was evidently south of that part. Whether a significant fact or only a coincidence, it is interesting that the two major structural features of the Little Hat-

Northern Sonora, Mexico," *Jour. Geol.*, Vol. 41 (1933), pp. 12-37. F. L. Ransome, "The Copper Deposits of Ray and Miami, Arizona," *U. S. Geol. Survey Prof. Paper* 115 (1919), pp. 56-57.

²⁴ R. E. King, "Geologic Reconnaissance of Central Sonora," *Amer. Jour. Sci.*, 5th Ser., Vol. 28 (1934), pp. 81-101. *Idem*, unpublished manuscript, based on field work in western Chihuahua, Mexico, in 1933.

chet Mountains—the Howells Wells syncline and the Copper Dick fault—roughly coincide with the position of the pivot axis.

Further information on the position of the shore line is given by the conglomerate members of the several formations, for the conglomerates are evidently littoral and marginal neritic deposits, derived from a cliff-bordered shore by an encroaching sea that scattered some of the pebbles and boulders along the beach while carrying others beyond the limits of low tide, and that eventually covered the site deeply enough, or wore back the shore far enough, to permit deposition of the several *Orbitolina* zones. The distance to which boulders and large pebbles can be carried seaward is limited to perhaps 10 or 15 miles at most;²⁵ therefore it may be inferred that the shore line during the conglomerate stages of deposition was somewhere within what is now the Eureka section of the range for the conglomerates of the Sylvanite section and only a few miles farther north for the conglomerates of the Eureka section. The cliffs during the Skunk Ranch interval of deposition perhaps were higher and more extensive than at other times, to judge from the great amount of Lower Cretaceous boulders they supplied and from the fact that Paleozoic rocks were exposed in them. The slabby shape of some of the boulders suggests that the cliffs were near by.

Some conglomerates probably were carried in by swift-moving streams, and the shore line was doubtless much closer at such times. That origin is particularly probable for the bouldery conglomerate of the Broken Jug limestone near the Ringbone Ranch and for the basal conglomerates of the Ringbone and Playas Peak formations. Some of the Skunk Ranch conglomerate also may have been carried in by streams. The fresh-water beds of the Ringbone and Playas Peak formations indicate the margin of marine sedimentation for those periods, and part of the actual shore line of the Ringbone basin is exposed.

An exposure near the center of the Pyramid Mountains, in the Lordsburg Quadrangle, shows the Hidalgo volcanics resting directly on Pennsylvanian limestone instead of on rocks of Trinity age, so that the northernmost position of the shore in pre-volcanic time must have been in the 18-mile area between that point and the north edge of the site of the Little Hatchet Mountains, unless, of course, some earlier Lower Cretaceous rocks once there had been eroded. This checks the inference stated in the foregoing that the shore line was less than 15 miles distant. The post-lava basin extended at least

²⁵ W. H. Twenhofel, "Marine Unconformities, Marine Conglomerates, and Thickness of Strata," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 20 (1936), pp. 677-703.

as far north as old Brockman station, about 12 miles north of the Little Hatchets, where the Hidalgo volcanics are overlain by massive limestone and quartzite that correspond with the Howells Ridge and Corbett formations.

The piling up of the Hidalgo volcanics to a thickness of 5,000 feet or more presumably was accompanied by a sinking of the crust over a broader area than the basin of sedimentary deposition. The center of volcanism seems to have been close to the edge of the geosynclinal basin and somewhat on the landward side, that is, north of the site of the Little Hatchet Mountains. This conclusion is suggested by the fact that some of the vents that yielded the Hidalgo volcanics have been recognized in the north half of the Lordsburg Quadrangle²⁶ and by the fact that the minor ejections during the Howells Ridge interval did not reach as far south as the site of the present Sylvanite district.

One further point may be considered, namely, the depth of water in which the materials were deposited. The significance of the conglomerates and of the fresh-water beds already has been mentioned, and it can be concluded that the entire section, exclusive of most of the volcanics, belongs to shallow-water and beach environments, as indicated by the general lithology, by the shallow-water coquina-making shells, and by the multiplicity of conglomerate members. The Corbett sandstone in particular suggests beach and marginal shallow-water conditions over a great area for a comparatively long interval. The massive and relatively pure *Orbitolina*-bearing limestones themselves do not necessarily mean deep water, but rather clear water far enough from shore to be beyond appreciable contamination by terrigenous material. In fact, at least the lower *Orbitolina*-bearing member of the Broken Jug limestone may be a reef limestone, as suggested by its rapid thinning, by the merging of the thin part into conglomerate, by the presence of *Orbitolina*-bearing masses of matrix limestone in the conglomerate, and by the general presence of such mollusks as *Toucasia* and rudistids, which are characteristic of the reef facies of the Trinity limestones in Texas.²⁷ The shoreward facies of the other *Orbitolina*-bearing limestones also are massive and rudistid-bearing and likewise may be reef limestones. As indicated by the top member of the Howells Ridge formation, the *Orbitolina*-bearing limestones extended seaward for some distance as well as parallel with the shore, but thinned appreciably seaward and became non-fossiliferous, a feature in some degree corroborative of the reef interpretation.

²⁶ S. G. Lasky, *op. cit.*, pp. 13-14.

²⁷ E. H. Sellards *et al.*, *op. cit.*, p. 268.

CONDITIONS OF SEDIMENTATION AND
SOURCES OF THE ORISKANY SAND-
STONE AS INDICATED BY
PETROLOGY¹

MARCELLUS H. STOW²
Lexington, Virginia

ABSTRACT

Exposures of the Oriskany formation were examined and samples collected between Monroe County, New York, and Monroe County, West Virginia. The lithologic character of the Oriskany and adjacent formations at ten localities is described. Samples were prepared by the usual methods of sedimentary petrography.

Two distinctly different heavy-mineral suites were found. The assemblage of tourmaline, zircon, rutile, leucoxene, indicative of derivation from sedimentary rocks, was characteristic of the Oriskany south of New York. The assemblage of garnet, hypersthene, kyanite, biotite, and amphiboles, in addition to those minerals just mentioned, is indicative of derivation from crystalline rocks as well as sedimentary rocks. This assemblage was confined to the Oriskany of New York.

The minerals indicate that south of New York the Oriskany sediments were derived from sedimentary formations exclusively, probably from Cambrian and Silurian sandstones, and that in the New York area they were derived directly from crystalline rocks of the Adirondacks as well as from sedimentary formations.

INTRODUCTION

Over a period of years the writer has studied exposures and collected samples of the Oriskany sandstone from Monroe County, New York, southward to Monroe County, West Virginia. Some of the results of the petrographic examination of the samples have been published.³

A comprehensive study of the petrography of the Oriskany sandstone as exposed from western New York to southern West Virginia has become of increasing importance with the exploration of this formation as a source of oil and gas. Herewith are presented descriptions and photographs of Oriskany exposures to show the great variation in thickness and lithologic character with discussion of conditions of sedimentation, tabulations of characteristic minerals and their percentages, brief descriptions of these minerals, and discussion of the sources of the detritus composing the formation.

¹ Manuscript received, January 20, 1938.

² Department of Geology, Washington and Lee University.

³ M. H. Stow, "An Occurrence of Oriskany Sandstone with Celestite Cement," *Amer. Jour. Sci.*, Vol. 16 (1928), pp. 446-50.

M. H. Stow, "Authigenic Tourmaline in Oriskany Sandstone," *Amer. Mineral.*, Vol. 17 (1932), pp. 150-58.

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During the progress of the early part of the investigation suggestions and criticism were given by members of the faculty of the Department of Geology of Cornell University. The late Dean H. D. Campbell of Washington and Lee University was of assistance in the field in Virginia and Professor B. R. Ewing, Jr., of the same institution, very generously provided transportation during the course of the work in Pennsylvania, Maryland, and West Virginia. Professor J. H. C. Martens of the University of West Virginia has read the manuscript and has given helpful advice.

THE TERM ORISKANY

The term Oriskany was first used by Hall and Vanuxem⁴ in 1839 and was applied to the sandstone formation cropping out at Oriskany Falls, Oneida County, New York. Previous to this time the formation had been described under various names by several geologists. It was first called the "Shell Grit" by Amos Eaton.⁵ Later in 1838 Vanuxem⁶ described it as the "White Sandstone," and in the following year Conrad⁷ wrote of it as the "Grey Brachiopodus Sandstone." In Pennsylvania H. D. Rogers⁸ called it "Division Number 7," and in Virginia it was first called the "Monterey Formation" by Darton.

This formation had been separated into various local subdivisions. Some of these are shown on a chart by Frank McKim Swartz.⁹ Here the upper part is called the Ridgeley sandstone and the lower part the Shriver chert. P. H. Price¹⁰ recognized a subdivision at the top of the Oriskany which he named the Huntersville chert. In the Maryland Geological Survey report on the "Lower Devonian" the formation is also divided into Ridgeley sandstone and Shriver chert. In the reports of the Second Geological Survey of Pennsylvania, the lower member is called the Stormville shale. In the *New York State Museum*

⁴ Lardner Vanuxem, "Geology of New York," *Rept. on Third District* (1842).

⁵ Charles Schuchert, "Lower Devonian Aspect of the Lower Helderberg and Oriskany Formations," *Bull. Geol. Soc. Amer.*, Vol. 11 (1900), p. 300.

⁶ Lardner Vanuxem, *Second Annual Report, Geol. Survey Third District of New York* (1838), p. 285.

⁷ T. A. Conrad, *Second Annual Report, Paleon. Dept., Geol. Survey of New York* (1839), p. 62.

⁸ H. D. Rogers, *First Annual Report, State Geol. Pennsylvania* (1836).

⁹ F. McKim Swartz, "The Helderberg Group of Parts of West Virginia and Virginia," *U. S. Geol. Survey Prof. Paper 158-C* (1929), p. 27.

¹⁰ P. H. Price, "Report on Pocahontas County," *West Virginia Geol. Survey* (1929), p. 236.

Bulletin 285, "Geology of the Capital District," Ruedemann¹¹ mentions the "thick mass of the blackish, gritty, or sandy Esopus shale" as a "different facies of the Upper Oriskany beds of later Oriskany sea."

For the purposes of this petrographic study, the formation from which collections were made was that mapped by Darton as the Monterey sandstone, mapped and described by the West Virginia, Virginia, Pennsylvania, and New York geological surveys as the Oriskany sandstone, and mapped and described by the Maryland Geological Survey as the Ridgeley sandstone. In other words, the formation examined lies between the overlying Romney shale and the Helderberg limestone in Virginia and Maryland, between the Marcellus shale and the Helderberg limestone in West Virginia, between the Marcellus shale and the underlying Stormville shale in Pennsylvania, between the Esopus grit and underlying Becraft limestone of eastern New York, and between the overlying Onondaga limestone and the Manlius (Silurian) or Helderberg (Devonian) limestones of western New York. The Oriskany sandstone and the Helderberg limestone are ordinarily closely associated. This is true throughout the length of the Appalachians and in New York, Illinois, Tennessee, and on the Gaspé Peninsula of Quebec.

Only localities in Virginia, West Virginia, Maryland, Pennsylvania, and New York are considered here. However, Oriskany sedimentation was much more extensive. In western Tennessee sediments of this age are known as the Camden chert, in northern Alabama as the Frog Mountain sandstone, and in northeastern Quebec as divisions 7 and 8 of the Gaspé limestone.

In New York, the Oriskany extends as a single line of outcrop beginning in Genesee County and continuing eastward across the central part of the state to the Hudson River in Albany County. Thence it extends southward into Ulster County, where it turns southwest, entering Pennsylvania near the Delaware River in Pike County. Through central and south-central Pennsylvania the formation is not exposed as a single line of outcrop, but is exposed in a series of long loops by erosion of folds. This series of nearly parallel outcrops extends across central and eastern Pennsylvania, across Maryland in the vicinity of Cumberland and Hancock, and into West Virginia. In Virginia and West Virginia the lines of outcrop are nearly parallel with the boundary between the states. Farther south

¹¹ Rudolph Ruedemann, "Geology of the Capital District," *New York State Museum Bulletin 285* (1930), p. 174.

GENERALIZED OUTCROP OF
ORISKANY FORMATION
FROM
GENESEE COUNTY, NEW YORK
TO
GILES COUNTY, VIRGINIA.

SCALE
0 10 20 30 40 50

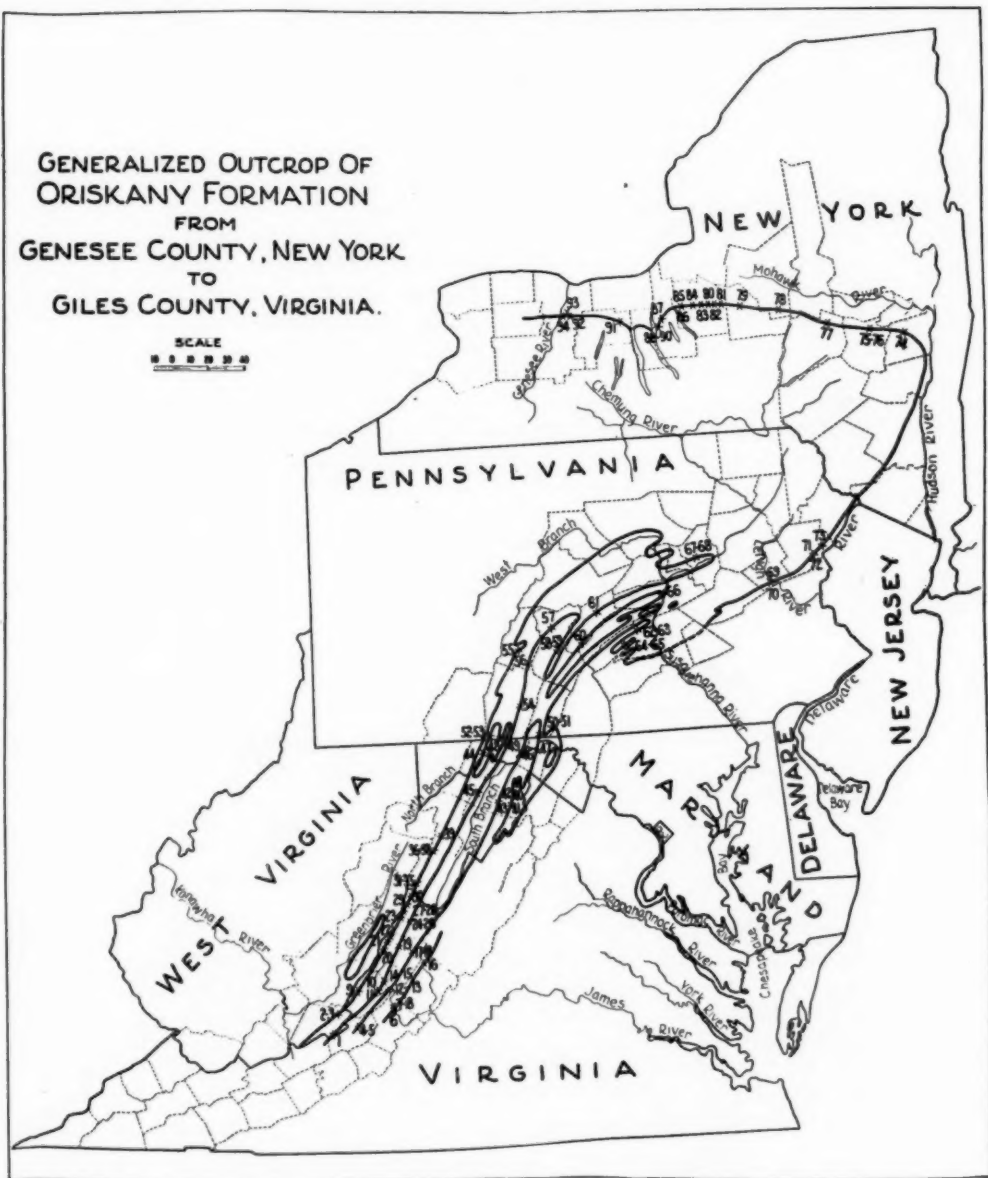


PLATE I.—Generalized outcrop of Oriskany sandstone from Genessee County, New York, to Giles County, Virginia.

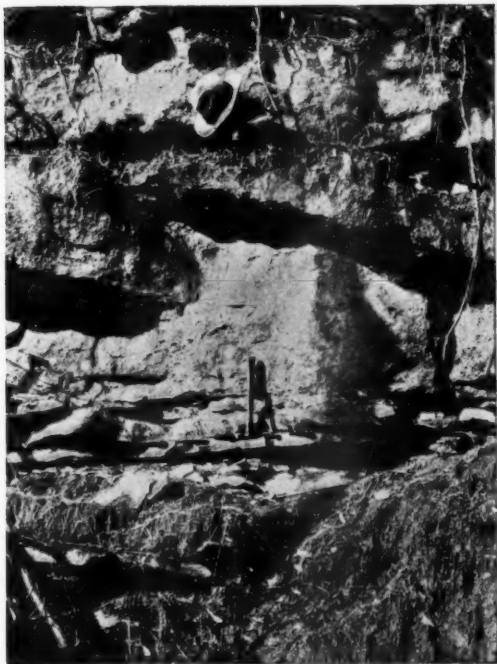


Plate 2.—FIG. 1.—Massive Oriskany sandstone 4 feet in thickness,
Phelps, Ontario County, New York.



FIG. 2.—Oriskany sandstone thinning toward left, 50 feet
from outcrop of Figure 1.

in these two states the formation is faulted out and is not exposed within the area under investigation. The generalized outcrop and localities from which samples were obtained or that were examined are shown on Plate 1. (See Table II for names of sample localities.)

ORISKANY SECTIONS AND CONDITIONS OF SEDIMENTATION

Lithologically the Oriskany varies greatly. The nature and extent of these variations perhaps can be presented best by descriptions of particular localities.

At Mertencia, Onondaga County, New York, the Oriskany horizon is represented by approximately an inch of calcareous clay between the Onondaga and Manlius limestones.

At Phelps, Ontario County, New York, the formation varies from approximately 4 feet (Pl. 2, Fig. 1) to a few inches (Pl. 2, Fig. 2) in a distance of 50 feet. It is hard dirty-white sandstone composed of quartz grains about $\frac{1}{2}$ millimeter in diameter, with large amount of celestite cement. Imbedded in the top layer are numerous black nodular masses (Pl. 3, Fig. 1) composed of sand grains bound by black cherty cement. This black matrix may considerably exceed the sand grains in quantity. Such black nodules are a characteristic feature of the top of the Oriskany wherever found throughout the area of the investigation. They probably represent a last phase of Oriskany sedimentation, Oriskany sand cemented into nodules rather than Oriskany reworked after consolidation.

At Kimber Springs, near Syracuse, New York, there is an outcrop in which the thickness of the formation varies from approximately 2 feet to 4 inches in a distance of 200 yards. Where it is thickest (Pl. 3, Fig. 2) it consists of clean quartz sand grains about $\frac{1}{2}$ millimeter in diameter, among which are scattered other quartz grains as large as 3 millimeters. In the top part of the formation are found black sand nodules like those at Phelps. The contacts between the Oriskany and the overlying Onondaga limestone and the underlying Helderberg limestone are sharp, there being no gradation from one to the other. Where the formation is thinnest, 6 inches (Pl. 4, Fig. 1), it consists of a concentration of the black sand nodules with very little sand associated with them.

At the type locality at Oriskany Falls, Oneida County, New York, the rock is a white-to-buff sandstone, loosely cemented and fossiliferous. Here it is exposed in a cliff having a height of about 20 feet, approximately the full thickness of the formation.

At Jersey Shore, Lycoming County, Pennsylvania, a sharp contact of the Marcellus shale and the Helderberg limestone was observed. No Oriskany was present between them (Pl. 4, Fig. 2).



PLATE 3.—FIG. 1.—Black, arenaceous, chert nodules imbedded in top layer of Oriskany sandstone, Phelps, Ontario County, New York.



FIG. 2.—Sharp contact of Oriskany sandstone and Onondaga limestone (above) and Helderberg limestone (below), Kimber Springs, Syracuse, New York.



PLATE 4.—FIG. 1.—Concentration of black, arenaceous, chert nodules representing total thickness of Oriskany, 200 yards from outcrop shown in Figure 2, Plate 3.



FIG. 2.—Contact of Marcellus shale (left) and Helderberg limestone (right). Oriskany absent. Jersey Shore, Lycoming County, Pennsylvania.

At Frankstown, Blair County, Pennsylvania, the change from Helderberg to Oriskany is transitional; toward the top of the Helderberg are several layers of sandstone alternating with limestone. On the upper limestone layer rests 12 feet of Oriskany. This section shows distinct textural divisions. At the bottom there is a 3-foot bed of brown sandstone with calcareous cement. The sand grains are about a millimeter in size. Next above is a 3-foot layer of very hard blue-gray sandstone, also calcareous, which is overlain by 3 inches of limonite-coated quartz grains resembling grains of wheat in size and shape. These well rounded and well sorted grains resemble those of a beach deposit. Mixed with them are many Oriskany fossils, concentrated as though by the wash of waves. This fossiliferous bed is overlain by 2 feet of soft brown sandstone of $\frac{1}{2}$ -millimeter quartz grains cemented by and coated with limonite. Above this is a 1-foot bed of wheat-like grains intermixed with Oriskany fossils, which in turn is overlain by 3 feet of soft brown sandstone that forms the top of the exposure. The Oriskany-Romney contact is not exposed here.

At Warren Point, Fulton County, Pennsylvania, is exposed the black, thin-bedded Romney shale (Pl. 5, Figs. 1, *a*, and 2, *a*), with a basal conglomerate made up of large pebbles of Oriskany sandstone interbedded with the shale (Pl. 5, Figs. 1, *b*, and 2, *b*). These pebbles extend 6 inches into the Romney above the top of the Oriskany. Between this basal conglomerate and the Becraft member of the Helderberg formation there are 52 feet of alternating beds of arenaceous limestone (Pl. 5, Figs. 1, *d*, and 2, *d*), and beds of quartz pebble conglomerate (Pl. 5, Figs. 1, *e* and *f*, and 2, *e* and *f*) described by the Maryland Geological Survey¹² as Oriskany. At the top of this Oriskany limestone, and immediately beneath the basal conglomerate, is 1½ feet of massive coarse conglomerate (Pl. 5, Figs. 1, *c*, and 2, *c*) composed of smoothly worn quartz pebbles ranging from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, and numerous Oriskany fossils. The upper 30 feet of this limestone is light gray, arenaceous, with four beds of clean quartz pebbles. The lower 19 feet of limestone is darker in color and not as sandy. Below this is a 3-foot bed of conglomeratic, dark gray limestone in contact with the underlying Becraft. This section gives some interesting clues to the conditions of sedimentation. Concerning this exposure the Maryland Geological Survey¹³ has published the following statement.

This is the best exposure of the Oriskany-Romney contact to be seen in this region, and adds considerable to the evidence we already have of a temporary

¹² "Lower Devonian," *Maryland Geol. Survey* (1913), p. 188.

¹³ *Ibid.*, pp. 188-89.

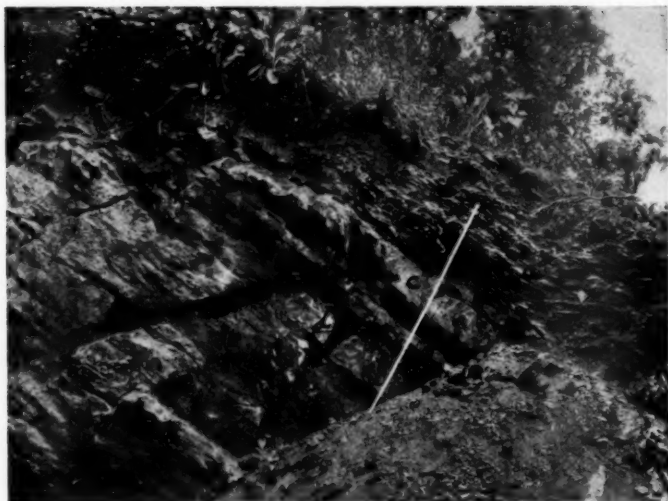


PLATE 5.—FIG. 1.—Romney shale (*a*). Basal conglomerate of Romney composed of Oriskany sandstone pebbles (*b*). Layer of coarse conglomerate composed of smooth quartz pebbles forming top of Oriskany (*c*). Layers of arenaceous limestone (*d*). Smooth quartz pebble conglomerate (*e* and *f*). Bottom of Oriskany not visible. Warren Point, Fulton County, Pennsylvania.

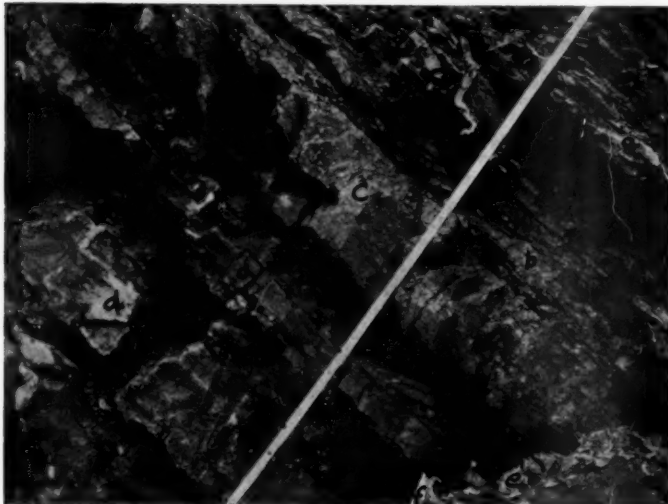


FIG. 2.—Same as Figure 1. Closer view.

land area at the close of the Oriskany. The conglomerate at the top of the Oriskany was formed when the land was rising and the basal conglomerate at the bottom of the Romney was formed while the land was sinking at the beginning of Romney deposition. The upper conglomerate of the Oriskany was only partially destroyed by erosion during its emergence and pebbles derived from this upper conglomerate are found for several feet in the base of the Romney.

In sharp contrast to the section at Warren Point is the one about 7 miles distant at the glass sand quarry (Pl. 6, Figs. 1 and 2) 2 miles south of Hancock, Maryland, toward Berkeley Springs, West Virginia. Here the Oriskany is a white sandstone composed of quartz grains approximately $\frac{1}{8}$ millimeter in diameter, with little cement. The formation is approximately 300 feet thick and shows no marked stratification. Throughout this region in Maryland, West Virginia, and Pennsylvania there are several deposits of Oriskany sandstone of similar thickness and purity. The rock is almost entirely silica and must have been thoroughly washed during deposition and probably again by percolating waters after consolidation; these processes removed nearly every trace of iron and other impurities. This indicates long continued wave action in relatively shallow water.

In Virginia the same general lithologic variations exist. In the section at Clifton Forge, Alleghany County (Pl. 7, Fig. 1), the Helderberg limestone gradually becomes sandy near the top and the Oriskany begins with a sandy fossiliferous layer that is followed by 3 inches of coarse conglomerate. The remaining 15 feet of Oriskany consists of alternating strata of sandstone and fine conglomerate. The conglomerate layers are more fossiliferous than the sandy layers. The contact between the Oriskany and the Romney shale is sharp and is marked by the black sandy nodules previously mentioned. Here again is evidence of fluctuating conditions of sedimentation such as would be found in shallow water along the shore.

Near Goshen, Rockbridge County, Virginia, at a sand quarry in the Oriskany (Pl. 7, Fig. 2), the formation is distinctly but irregularly bedded, although no prominent changes in grain size are apparent. Such a section doubtless represents deposition under more constant conditions than those indicated by the section at Clifton Forge.

These sections are typical examples of the variation from place to place and from bed to bed of the lithologic character of the Oriskany formation from New York to the Virginias. There are deposits of medium-grained sandstone of considerable thickness, even texture, and great purity; deposits in which there is distinct stratification due to the abrupt changes in the grain size of the sediment; and de-



PLATE 6.—FIG. 1.—Oriskany glass sand quarry between Hancock, Maryland, and Berkeley Springs, West Virginia.



FIG. 2.—Same, another view.

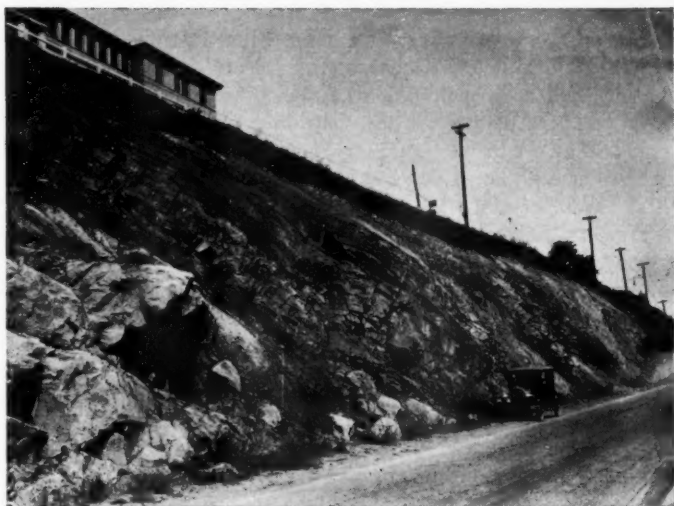


PLATE 7.—FIG. 1.—Oriskany sandstone, Romney shale above, Helderberg limestone below. Clifton Forge, Alleghany County, Virginia.



FIG. 2.—Oriskany sandstone. Goshen, Rockbridge County, Virginia.

posits that are highly calcareous or limonitic. In some localities the Oriskany is completely absent or it is represented by only a thin layer of argillaceous material. Although these variations may occur within comparatively short distances, in general the Oriskany sandstone is thickest in western Maryland and adjacent West Virginia and it thins both north and south along its outcrop.

The presence of marine fossils of Lower Devonian age throughout the area is sufficient evidence of the age and general marine character of the Oriskany sandstone deposited in the Appalachian geosyncline.

The predominance of quartz sand, its coarseness, purity, sorting into local beds and lenses of sandstone and conglomerate, are all evidences of a near-shore, shallow-water environment of deposition. Likewise, the marine fauna indicate the same type of environment.

Transgression of the Oriskany sea is indicated by the sandstone deposits that overlap the older formations. Such transgression and corresponding unconformity is also indicated by fragments of the underlying limestone inclosed in the basal beds of the sandstone.

UNCONFORMITIES

Throughout the area there is evidence of unconformity either above or below the Oriskany formation. Several quotations from published works suffice to illustrate. Concerning the upper conformity between the Romney shale and the Oriskany sandstone, the Maryland Geological Survey¹⁴ writes:

The Lower Devonian was formerly thought to be terminated by a marked hiatus. Unconformity by erosion was reported by Darton between the Oriskany and Romney of Virginia. This view has been held by most subsequent observers. The belief was based, in part, upon the supposed absence of the Onondaga fauna in Maryland and adjacent areas. It has recently been shown by Kindle, however, that the Onondaga fauna is present in the basal beds of the Romney. While the magnitude of any hiatus at the close of the Oriskany must therefore be small, the occurrence of at least a short erosional unconformity at that horizon is indicated by the following facts: the great abruptness of the transition from the Oriskany to the Romney, the apparent erosion of the upper surface of the Oriskany at many places, its varying thickness, and the local development of a basal conglomerate in the Romney, the latter being well shown at Warren Point, Fulton County, Pennsylvania, just north of the Maryland-Pennsylvania line.

The basal conglomerate in the Romney, referred to above, consists of hard pebbles of Oriskany sandstone in the basal beds of the Romney shale.

Unconformity at the base of the formation is shown at several

¹⁴ *Ibid.*, p. 95.

localities. In western and central New York there are several exposures where the Oriskany is thin and contains fragments of the underlying limestone. Concerning this unconformity in New York, John M. Clarke¹⁵ writes that at a limestone quarry near Buffalo

The horizon of the Oriskany is indicated only by a thin seam of fine bituminous matter, containing no sand except in a few depressions, where small characteristic nodules of black sand are found. In certain parts of this section the upper hydraulic or "bullhead" strata show very positive evidence of disturbance and folding and at certain places the crest of these folds is seen to be partially removed, while the Onondaga limestone beds lie horizontally on them. All these evidences are indicative of an interval of unrepresented time between the deposition of the Manlius limestone and the commencement of Onondaga sedimentation.

Furthermore, the Oriskany is not underlain by the same formation throughout its extent and in many places it shows a sharp change in lithologic character from limestone to coarse clastic sediment. This not only indicates unconformity, but likewise indicates adjacent land rejuvenation. However, field observations in southern Pennsylvania, Maryland, Virginia, and West Virginia have shown that at all localities where the contact of the Oriskany and the underlying Helderberg limestone was exposed, the contact was a gradational one; the transition was from limestone through a sandy limestone into the typical sandstone of the Oriskany. This seems to indicate slight, if any, unconformity between the Helderberg and the Oriskany in the southern part of this area.

FIELD AND LABORATORY PROCEDURE

At each locality samples for petrographic examination were collected. Each sample consisted of about 5 pounds of unweathered chips taken from an area of several square yards. Where the thickness of the section warranted, at least three such samples were collected, one each from the top, middle, and bottom of the section. By this method about 290 specimens were obtained from the 88 localities visited. Of this number 116 were examined petrographically and results of 94 of these are presented herewith.

In the geological laboratories of Cornell and Washington and Lee Universities the samples collected were prepared for microscopic examination of the mineral constituents by the usual methods of sedimentary petrography. Mineral percentages were obtained by grain counts.

¹⁵ J. M. Clarke, "The Oriskany Fauna of Becraft Mountain, Columbia County, New York," *New York State Museum Mem. No. 3*, Vol. 3 (1900), p. 96.

DESCRIPTIONS OF MINERALS

LIGHT MINERALS

Quartz, as would be expected, was the predominant light mineral of the samples, in more than half of which it made up 100 per cent of the light separates, and in 90 per cent it represented 90 per cent of the light material.

Chert was present in appreciable quantities in only about 10 per cent of the samples, but in 3 per cent of them it was present almost to the exclusion of quartz.

Feldspars were found in about 20 per cent of the samples examined. Orthoclase and microcline were identified; the members of the plagioclase series were not differentiated. In four specimens from a small area in Highland County, Virginia, the feldspars make up from 8 to 16 per cent of the light separates. This is the only place in which they were found in appreciable quantities. Throughout the area much of the feldspar is considerably weathered, but most of it is fairly fresh and does not show extensive alteration. This is indicated by its clearness, sharpness of cleavage, and sharpness of extinction between crossed nicols.

HEAVY MINERALS

Zircon was found in essentially every sample of the Oriskany examined. The physical characteristics of the mineral were surprisingly uniform throughout the area; the vast majority of the grains were colorless, clear, elongate, and well rounded. Euhedral grains were very scarce and a few pale pink grains were found.

Tourmaline was as ubiquitous as zircon, and its physical properties were likewise uniformly similar throughout the area. The grains were ordinarily well rounded, but here and there a euhedral crystal was encountered. Most of them were strongly pleochroic, shades of brown were most common, with the shades of green next in abundance; purple and blue shades were rare. There was no uniform or significant distribution of the grains of various colors, either stratigraphically or geographically.

Rutile, although not found as generally as zircon and tourmaline because of its smaller proportion in the heavy separates, was, nevertheless, found in most of the samples. The two common colors of detrital rutile, reddish brown and yellowish brown, were observed with about equal frequency. All of the grains were well rounded, and a few showed twinning.

Leucoxene likewise was not as common as zircon and tourmaline but was found in most of the samples. It occurred as opaque rounded

TABLE I
MINERAL PERCENTAGES

Sample No.	Quartz	Plagioclase	Orthoclase	Microcline	Chert and Clay	Tourmaline	Zircon	Leuczoene	Limsonite	Rutile	Pyrite	Chlorite	Amphiboles	Hypersthene	Garnet	Kyanite	Ilmenite and Magnetite	Biotite	Celestite	% Heavy Minerals in Total Sample.
1	100					10	10		80											0.2
2	100					14	65	20	1	+										0.1
3	75				25	20	20		60											0.2
4	100					1	1		98											0.3
5	100					7	3	75	15											0.06
6	100					1	1		98											1.0
7	100					15	5		80											0.1
8	100					1	1		98											0.1
9	100					20	25	15	40											0.06
10	100					1	1	1	97											0.4
11	100					2	3		95											0.2
12	100					12	10	1	77	+										0.1
13	100					20	15		65											0.1
14	100					20	10	70												0.1
15	100					15	70	15		+										0.4
16	100					60	30	10												0.2
17	100					30	50	20		+										0.2
18	100					20	23	55		2										0.2
19	100					28	22	47		+	3									0.1
20	100					20	5	5	70	+										0.2
21	100					20	40	40												0.1
22	100					15	25	58		2										0.1
23	100					15	40	44		1										0.2
24	100					2	3		95											0.2
25	100					1	25	59	15	+										0.2
26	100					10	30	59		1										0.2
27	90	3	5	2		10	30	60		+										0.1
28	90	3	5	2		5	5	65	25	+										0.2
29	91	3	5	1		20	30	50		+										0.2
30	84	3	10	3		20	10		70	+										0.2
31	100					5	5	30	60											0.2
32	97	1	1	1		20	1	20	59	+										0.1
33	97	1	1	1		5	5	40	50	+										0.1
34	97	1	1	1		1	1		98											0.2
35	97	1	1	1		10	2				88									2.0
36	97	1	1	1		15	40	15	30	+										0.2

TABLE I (continued)
MINERAL PERCENTAGES

Sample No.	quartz	plagioclase	Orthoclase	Microcline	Chert and Clay	Tourmaline	Zircon	Leucorene	Limonite	Rutile	Pyrite	Chlorite	Amphiboles	Hypersthene	Garnet	Kyanite	Ilmenite and Magnetite	Biotite	Celestite	% Heavy Minerals in Total Sample.
37	94	20	2	2		10	10	30	50	+										0.20
38	97	1	1	1		15	10	65	5	+		5								0.2
39	93	20	3	2		15	25	30	30											0.1
40	100					20	10	60	10											0.1
41	100					30	20	20	30											0.1
42	100					5	15	50	30											0.1
43	100					5			45	+										0.1
44	100					5	5		90							50				0.2
45	95	3	1	1		1	1	10	88											0.2
46	100					3	92	5		+										0.1
47	100					25	15	45	15											0.5
48	100					20	45	35												0.1
49	100					10	60	15	15											0.1
50	100					10	20	70		+										0.2
51	99				1	10	59	30		1										0.2
52	94	2	4			15	10	52		2		21								0.2
53	90	5	4	1		10	10	48		+		32								0.2
54	100					20	15	50	15	+										0.1
55	88	1	1		10	20	10	70		+										0.1
56	72	1	1	1	25	5	20	65		2		8								0.1
57	100					15	5	30	50	+										0.2
58	100					65	20	15		+										0.05
59	100					8	2	80		+		10								0.1
60	100					20	40	38		2										0.2
61	100					15	10		75											0.1
62	97	1	1	1		10	10	70		+		10								0.1
63	97	1	1	1		5	3	45	45	+		2								0.2
64	100					1	1	60	38											0.1
65	100					7	10		80	+		3								0.1
66	10				90	1	1		98											0.1
67	10				90	10	15		70	+		5								0.1
68	10				90	10	15	75		+										0.1
69	100						10		80		10									0.2
70	100							70	30											0.4
71	50				50	5	5	50				40								0.2
72	50				50		1		79	+	20									0.2

TABLE I (continued)
MINERAL PERCENTAGES

[illegible]

grains, white in color and porcelaneous in texture. This mineral doubtless represents an alteration product of ilmenite; in some of the microscope slides all degrees of alteration of ilmenite to leucoxene were observed, from black grains of ilmenite with a few white patches on the surface to grains of leucoxene with an ilmenite core.

Ilmenite and *magnetite* were not differentiated. They were not commonly found, probably because the magnetite had altered to limonite and the ilmenite to leucoxene.

Garnet was present in only about 6 per cent of the samples and was ordinarily pale pink and angular.

Hypersthene was observed in about 6 per cent of the slides. The angular cleavage fragments showed pink-to-green pleochroism so characteristic of this mineral.

Kyanite as the typical angular grains showing pronounced cleavage planes was found in only 3 per cent of the samples.

Amphiboles were represented by grains having the ordinary optical properties of this group of minerals. Although no attempt was made to determine the exact variety, most of them were angular cleavage grains with blue-green to yellow-green pleochroism and were probably hornblende.

Chlorite was found sporadically in about 12 per cent of the samples. The grains were pale green aggregates and flakes.

Biotite was present in only 2 per cent of the samples, as weathered brown flakes.

The heavy minerals of probable authigenic origin were, in order of decreasing frequency, *limonite*, *pyrite*, and *celestite*. *Limonite*, in brown spongy aggregates, was present in most of the samples, probably as an alteration product of magnetite and pyrite. *Pyrite*, in 16 per cent of the samples, was generally present as euhedral crystals or aggregates of crystals. The occurrence of *celestite* as an authigenic mineral in the Oriskany at Phelps, New York, has been described elsewhere.³

SIGNIFICANCE OF MINERALS

Table I shows the total percentage, by weight, of heavy minerals in each sample, and also the percentage, by grain count, of the various minerals in each of the heavy and light separates of the various samples. Table II gives the locality from which each sample was obtained, its position in the Oriskany section, and the thickness of that section.

It was found that 5 per cent of the samples had less than 0.1 per cent of heavy minerals, 39 per cent had 0.1 per cent of heavy minerals,

SOURCES OF ORISKANY SANDSTONE

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TABLE II
LOCALITIES OF SAMPLES

<i>Sample</i>	<i>Locality</i>	<i>Position in Oriskany</i>	<i>Thickness of Oriskany</i>
			<i>Feet</i>
1	Gap Mills, Monroe Co.	W. Va.	Middle
2	Sweet Springs, Monroe Co.		Top
3			Bottom
4	Peters Hill, Craig Co.	Va.	Top
5			Bottom
6	Eagle Rock, Botetourt Co.		Top
7	Big Hill, Botetourt Co.		Top
8			Bottom
9	Stack Mines, Alleghany Co.		Middle
10	Island Ferry, Alleghany Co.		Top
11			Bottom
12	Iron Gate, Alleghany Co.		Top
13			Bottom
14	Clifton Forge, Alleghany Co.		Middle
15			Bottom
16	Goshen, Rockbridge Co.		Middle
17	Panther Gap, Bath Co.		Top
18			Bottom
19	Milboro Springs, Bath Co.		Middle
20	Bath Alum Springs, Bath Co.		Middle
21	Warm Springs, Bath Co.		Middle
22	Clecks Mills, Bath Co.		Middle
23	Wilsonville, Highland Co.		Bottom
24	McDowell, Highland Co.		Top
25			Top
26			Bottom
27	Pinkney, Highland Co.		Middle
28			Bottom
29	Monterey, Highland Co.		Middle
30	Strait Creek, Highland Co.		Middle
31	Franklin, Pendleton Co.	W. Va.	Top
32			Middle
33			Bottom
34			Top
35			Bottom
36	Smoke Hole, Pendleton Co.		Top
37			Middle
38			Bottom
39	Petersburg, Grant Co.		Middle
40	Capon Bridge, Hampshire Co.		Top
41			Bottom
42	Hanging Rock, Hampshire Co.		Top
43			Bottom
44	Ridgeley, Mineral Co.		Top
45	Mill Creek Mt., Hampshire Co.		Bottom
46	Berkeley Springs, Morgan Co.		Top
47			Bottom
48	Martin Mt., Allegany Co.	Md.	Top
49			Bottom
50	Warren Point, Fulton Co.	Pa.	Top
51			Bottom
52	Hyndman, Bedford Co.		Top
53			Bottom
54	Everett, Bedford Co.		Bottom

TABLE II (continued)

Sample	Locality	Position in Oriskany	Thickness of Oriskany <i>Feet</i>
55	Frankstown, Blair Co.	Top	
56		Bottom	15
57	Huntingdon, Huntingdon Co.	Bottom	30
58	Mill Creek, Huntingdon Co.	Top	
59		Bottom	164
60	Newton Hamilton, Mifflin Co.	Top	20
61	Lewistown, Mifflin Co.	Middle	150
62	Newport, Perry Co.	Top	
63		Bottom	100
64	New Bloomfield, Perry Co.	Top	
65		Bottom	92
66	Selinsgrove, Northumberland Co.	Top	?
67	Bloomsburg, Columbia Co.	Top	
68		Bottom	10
69	Bowmanstown, Carbon Co.	Top	
70		Bottom	170
71	Experiment Mills, Monroe Co.	Top	
72		Bottom	45
73	Broadhead Creek, Monroe Co.	Bottom	75
74	Knox, Albany Co.	Top	3
75	Shutters Corners, Schoharie Co.	Top	
76		Bottom	3
77	East Springfield, Otsego Co.	Middle	?
78	Oriskany Falls, Oneida Co.	Top	20
79	Perryville, Madison Co.	Middle	4
80	Rockwell Springs, Onondaga Co.	Middle	8
81	Jamesville, Onondaga Co.	Middle	3
82	Jamesville Lake, Onondaga Co.	Middle	2
83	East Onondaga, Onondaga Co.	Entire	1
84	Split Rock, Onondaga Co.	Entire	3
85	Skaneateles Falls, Onondaga Co.	Top	
86		Bottom	9
87	Aurelius, Cayuga Co.	Middle	?
88	Union Springs, Cayuga Co.	Top	
89		Middle	?
90		Bottom	
91	Phelps, Ontario Co.	Bottom	3
92	Spring Creek, Monroe Co.	Entire	
93	Honeoye Creek, Monroe Co.	Entire	
94	Honeoye Falls, Monroe Co.	Entire	

39 per cent had 0.2 per cent, 2 per cent of them had 0.3 per cent, 4 per cent of them had 0.4 per cent and 11 per cent had 1 per cent or more of heavy minerals. These percentages include limonite, which was very plentiful in many of the samples. Although total percentages of heavy detrital minerals, computed without limonite, pyrite, or celestite, are not available, examination of the table shows that the total percentages would be much smaller if these minerals could be eliminated from the computations. If such minerals be discounted, it is seen that in most of the samples there is an unquestionable pre-

dominance of zircon and tourmaline, and relatively small amounts of leucoxene, rutile, and magnetite, or ilmenite. Suites of heavy minerals characterized by tourmaline, zircon, rutile, leucoxene, and ilmenite, to the exclusion of other heavy detrital minerals, are indicative of derivation from pre-existing sediments.

Beginning with sample 74 (Table I) from Knox, Albany County, New York, and continuing down the table, with successive samples from east to west along the outcrop of Oriskany in New York, it is noticed that in addition to the ordinary high percentage of tourmaline, zircon, rutile, and leucoxene, there is present a small percentage of a few other highly significant heavy detrital minerals. These are garnet, hypersthene, kyanite, biotite, and amphiboles. This suite, being distinctly different from the exclusively tourmaline-zircon-rutile-leucoxene suite, indicates a different kind of source rock from which some of the Oriskany sediment of this area was derived. The continued predominance of zircon and tourmaline probably shows that pre-existing sediments were the main source of the New York Oriskany, but the second suite certainly indicates a crystalline rock source of derivation.

SOURCE OF SEDIMENTS IN NEW YORK AREA

The problem of the source of hypersthene, amphiboles, kyanite, garnet, and biotite resolves itself into a search for an area of crystalline rocks exposed to denudation during Oriskany time. The Adirondack Mountains seem to be the logical source of these minerals. The first question to be raised is, were the Adirondack crystalline rocks exposed to denudation at the time the Oriskany sediments were accumulating? Under the topic, *First Known Uplift of the Adirondacks*, W. J. Miller¹⁶ writes:

Just when the uplift occurred can not be positively stated, but there is much evidence favoring the idea that it was concomitant with the great igneous intrusions, especially of the syenite-granite,

and that was in pre-Cambrian time. Miller¹⁷ also states:

The profound erosion of the ancient Adirondacks extended through millions of years of the later pre-Paleozoic and even into very early Paleozoic time.

Hence the crystalline rocks of this area were being eroded and were supplying sediment to the early Paleozoic seas. It is well known that the minerals in question, hypersthene, amphiboles, kyanite, garnet,

¹⁶ W. J. Miller, "The Adirondack Mountains," *New York State Museum Bull.* 193 (1917), p. 40.

¹⁷ *Ibid.*, p. 41.

and biotite, are found in many of the Adirondack igneous and metamorphic rocks.

The predominance of the tourmaline-zircon-rutile-leucoxene suite over the hypersthene-amphibole-kyanite-garnet-biotite suite is evidence that pre-existing sedimentary rocks, doubtless the Cambrian and Silurian sandstones, supplied most of the Oriskany sand.

The unaltered condition of the chemically unstable hypersthene, amphiboles, and biotite and the sharpness and angularity of these easily fractured and cleavable minerals seem to preclude their presence being due to a second cycle of sedimentation with their derivation directly from Cambrian and Silurian sandstones. These minerals indicate that streams draining areas of the crystalline rocks of the Adirondacks were transporting some products of denudation of these crystalline rocks to the New York area of the Oriskany sea.

SOURCE OF SEDIMENTS SOUTH OF NEW YORK

South of the New York area no detrital minerals indicating direct crystalline rock derivation were found. The ubiquitous suite of tourmaline, zircon, rutile, and leucoxene grains, all well rounded, is definite evidence of derivation from pre-existing sedimentary rocks. It is probable that Cambrian and Silurian sediments were exposed to denudation along the entire western front of Appalachia and hence were in favorable location to supply coarse sediment to the near-shore shallow water of the encroaching Oriskany sea. The complete absence of less resistant minerals of direct crystalline rock derivation seems to indicate that the pre-Cambrian crystalline core of Appalachia was not supplying sediment to this early Devonian sea.

GEOLOGICAL LIMITATIONS TO OIL LAW¹

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ABSTRACT

It is pointed out that the recent proposals to discard the "rule of capture" in favor of "ownership in place" are limited by geological considerations which, in many cases, make such determinations of ownership impossible. It is further pointed out that operation under the rule of capture need not preclude the use of good engineering principles, and it is suggested that stabilization be considered on its own merits without being confused with conservation.

INTRODUCTION

The rule of capture has long been the dominating principle in determining ownership of oil and gas, mainly because of the impossibility of determining ownership on any other basis. It is the writer's contention that now after 75 years of oil-field development enough is not yet known about underground conditions to determine and apportion oil in place on any better basis. There are still too many subsurface unknown factors in too many places to warrant a new legal concept.

Contributions from the fields of physics and petroleum engineering in recent years have provided a store of valuable information on the physics of oil and gas behavior, and such information is of inestimable importance to the oil industry. It is also of importance, however, that the limited application of these researches be recognized. The tendency is to assume that this new fund of engineering and physical information has increased our knowledge to the point of enabling us to determine and apportion underground oil and gas resources on the basis of surface ownership. It is frequently stated that the rule of capture is obsolete, and that it should be supplanted by the principle of ownership in place. It is further being taken for granted that our new found physical data have sufficiently wide reliable application to form the basis for legislation.

It should be obvious that no matter how much we know about the physics of oil and gas behavior, we have no basis for new legal precepts until we also know *where* the principles are operative. Until we know where measurable data and conclusions exist and operate throughout a field removed from the point of measurement, we have

¹ Manuscript received, December 31, 1937.

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no new basis for changing the rule of capture. The physicist and petroleum engineer seem willing to interpolate and extrapolate, and assume the underground continuity of geological conditions. Yet geologists who have studied stratigraphy, structure, and lithology in detail know that in too many cases uniform reservoir conditions do not persist,—even in many places for the 10-acre spacing distance of 660 feet. M. Albertson in "Estimation of Developed Petroleum Reserves"³ says,

Geological assumptions of conditions existing between points of known conditions can be made that will be acceptable as to accuracy by all but the super-critical.

Acceptance of Albertson's statement is essential if compulsory wide well spacing, unitization, and allocation of oil on the principle of ownership in place are to be effective. If it is not generally applicable then in spite of recent research we have no new reasons for discarding the rule of capture.

Earl Oliver, chairman of the stabilization committee of the American Institute of Mining and Metallurgical Engineers, Petroleum Section, voices a similar confidence in subsurface geology in, "Can the Rule of Capture Be Rationalized?"⁴ He says,

Under those conditions [of a virgin pool whose contents have been undisturbed] appraisal engineers can determine relative acreage content by means of a preliminary exploratory drilling campaign with such reasonable dependability as will satisfy the standard set by the United States Supreme Court quoted above.

The court quotation is,

... the law, which is said not to require impossibilities, must be satisfied in many of its applications with fair and reasonable approximations.

The writer is not oblivious to some of the defects and so-called defects in the rule of capture. He merely wishes to suggest some well known and rather widespread types of geological phenomena that are inconsistent with the foregoing assumptions, and to suggest further that the geological limitation of such assumptions will probably prevent any other principle from working any better than the rule of capture.

An example of this is the Santa Maria Valley field, a major California field discovered in 1936, which field illustrates the impossibility of compulsory acreage allocations, and the impossibility of deter-

³ *Trans. Amer. Inst. Min. Met. Eng., Petroleum Development and Technology*, 1937, p. 14.

⁴ *Ibid.*, 1937, p. 142.

mining ownership in place by engineering methods. A 4,000-barrel well was offset 660 feet by a 150-barrel well. Two wells exactly $\frac{1}{2}$ mile apart produced approximately 3,000 barrels per day and 700 barrels per day, respectively, while an offset on a straight line between them produced only 250 barrels per day. Two wells approximately 1,400 feet apart were each producing less than 400 barrels per day. A well drilled on a straight line between them produced more than 1,500 barrels per day. It is necessary to drill to find out how much oil exists in place under various lands. As all these discrepancies occur between wells less than 700 feet apart, and within the total limits of the field, the futility of determining ownership in place is apparent. After the subsurface characteristics of such a field are reasonably well known, and the good and bad spots are discovered by drilling, the problem is solved, too late for the principle of ownership in place to have any value.

GEOLOGICAL FACTORS

A few oil-field conditions which confound any attempt to delineate an undeveloped field, and to allocate expense of exploration and production on an acreage basis are here stated.

Faults.—Faults, discernible at the surface or known only from subsurface information, are the rule rather than the exception in California oil fields, and their effects are many. The producing zone may be below the water table and be non-productive on the down side. Faulting may let water in and cause wet, poorly productive, areas within a field. Low-angle normal faults may remove the producing zone entirely from a part of the field. Reverse faults may duplicate or partly increase the thickness of the producing zone and create highly productive areas within a field.

Where faults are buried beneath unconformities hundreds or thousands of feet deep, as they are, for example, at Wilmington, Santa Maria, and Mountain View, California, there is no engineering technique known that can determine their effects on per acre total production until the field is developed.

Buttressing.—Buttressing of basal sands over high spots on a surface of deposition is a rather common phenomenon which is illustrated by Figure 1, a diagram of part of the East Cat Canyon field in Santa Barbara County, California.

Surface structural mapping and contours on the top of the oil sand indicate that the Golconda well, West No. 1, is at the most favorable structural location on the diagram. Actually it had only 40 feet of oil sand, whereas the closest well, about 660 feet east

(No. 14) had 263 feet of oil sand. Any allocation of production on the basis of ownership in place would have recognized the superior

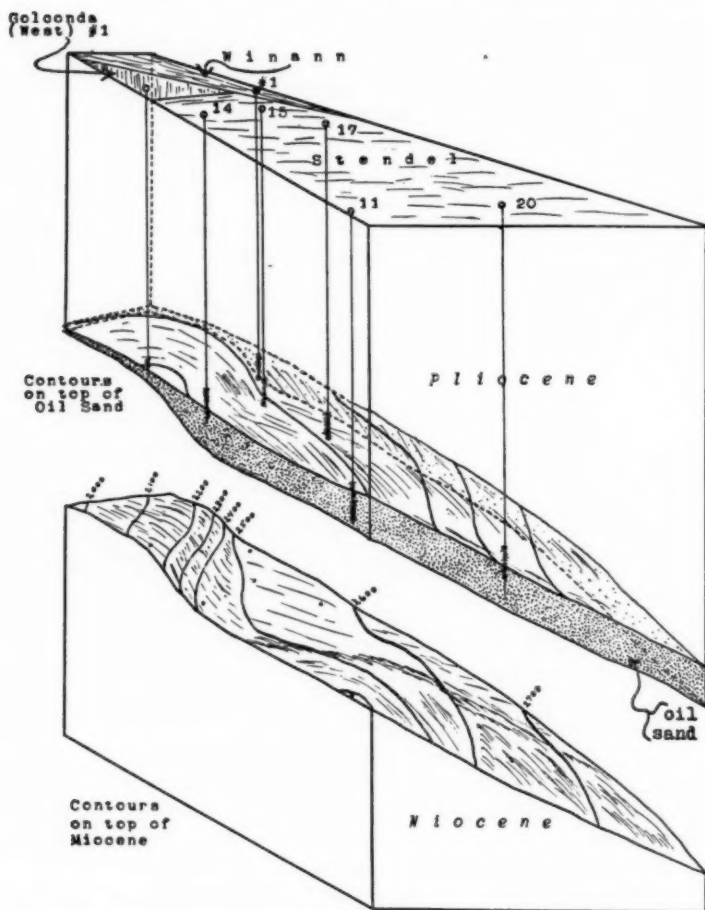


FIG. 1.—Diagram of part of East Cat Canyon field, Santa Barbara County, California, which illustrates short-distance variation in reservoir conditions through buttrressing of sands.

structural position, and would have assumed underground uniformity; the owner of the 40 acres would have received a share of his neighbor's oil; and under unitization, he would have been assessed

with his neighbor, a share of the expense for exploration. It is obvious that allocation on any basis other than with testing by drilling a well, would have been unfair to the owners of the oil. Engineering estimates of ownership in place would have been wrong. Compulsory allocation of production and expenses would have been found to be without basis. The problem of straightening out such a financial tangle,—value of use of capital, damage for loss of capital, interest on money wrongly assessed and wrongly distributed, *et cetera*,—make the difficulties under the rule of capture seem relatively small. Adjustment problems that may come late in the life of a field from discovery that original estimates and allocations, which owners were compelled to accept, were wrong, must be considered, and not lightly.

Another example of buttressing that would have confounded all original engineering estimates of oil in place is the Playa del Rey part of the Venice field in the Los Angeles Basin, California. The field was discovered in November, 1929, and fairly rapidly developed. In the spring of 1934 a mortgage company attempted to dispose of some land southeast from the developed field at a price very reasonable for the fee title to oil land. It can be presumed that engineering estimates of the extent of the field did not include the land, since it could not be sold. However, in November, 1934, an independent operator brought in a 5,000-barrel well in the area, and the said land now contains a number of wells. The explanation of the accumulation after development, is that the oil occurs in sands buttressed around irregularities in the basement schist.

A somewhat similar problem that baffles estimates occurs in the recently discovered El Segundo field in the Los Angeles Basin, concerning which the *California Oil World* of April 5, 1937, says,

It is becoming increasingly evident that the El Segundo field is one in which almost anything may be expected, and that every well drilled must be considered by itself without regard for the performance of other wells in the immediate area.

The writer has confirmed this opinion in conversations with geologists for some of the companies operating in the field.

Unconformities.—An unconformity at depth with producing horizons below it may almost nullify geological concepts formed during exploration. The Gato Ridge field in Santa Barbara County, California, is a case in point. Although several dry holes, and ten wells producing from 60 to 2,500 barrels of oil per day have been drilled, the structure and stratigraphy of the Miocene producing formation below the basal Pliocene unconformity are, as yet, very vaguely understood.

The structure may be asymmetrical and the axis at depth may not coincide with the surface fold. This condition may remain unknown until several wells have been drilled. Erosion may have scalped producing zones from the crest, as in the Oklahoma City field;⁵ and increased dips may have narrowed the productive limits.

The effects of faults below unconformities have already been mentioned.

Overlaps.—The foregoing paragraph mentioned unconformities as masks obscuring underlying conditions. Unconformities as seals have a different effect; and unconformities as avenues for migration have still a third effect. The compound possibilities of oil accumulation under the two latter types where a younger series of interbedded sands and shales overlies the truncated strata of an older oil-bearing series, perhaps with buttressing, are numerous. Many such occurrences have been described in the literature, an important example being the Sunset-Midway field in the San Joaquin Valley, California.⁶

Such accumulations are difficult to find, and difficult to follow. In some places the scale of geological processes is so great that the oil-bearing segment of the overlap is, within itself, a reasonably uniform unit. However, where the Pacific Coast type of geology prevails, that is, where important geological changes can and do occur within distances shorter than the dimensions of individual fields, estimates of reservoir conditions will be subject to radical revision as development progresses.

Variable porosity and permeability.—Variation in porosity and permeability occurs in almost any sand whose depositional environment varied within short distances, as it did in the Tertiary basins of California. Lack of underground continuity of uniform porosity is also a problem in the Mid-Continent according to data on Mid-Continent fields presented by O. L. Brace.⁷ He also mentions the mechanical difficulty in obtaining adequate core recovery, which is also a California problem, as some core recovery in the oil zone is less than 10 per cent.

Lenticularity.—Curvature of sand lenses, by varying the sand thickness, of course, materially affects the quantity of oil under any surface subdivision. No accurate appraisal can be made until the shape, size, curvature, and lithologic character of the lens is known

⁵ A. I. Levorsen, "Stratigraphic versus Structural Accumulation," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 20, No. 5 (May, 1936), p. 526.

⁶ R. W. Pack, "The Sunset-Midway Oil Field, California," *U. S. Geol. Survey Prof. Paper* 116.

⁷ O. L. Brace, "Factors Governing Estimation of Recoverable Oil Reserves in Sand Fields," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 18, No. 3 (March, 1934).

where ownership in place is to be determined. Where sand thickness changes as much as 200 feet in 660 feet horizontally, as at East Cat Canyon (Fig. 1), or where a lens 100 feet in thickness disappears entirely between two locations 660 feet apart, as at Sunset-Midway,⁸ any estimate of the oil in place based on assumption of geological continuity would be wrong by several hundred per cent. This is certainly a standard of accuracy far below the previously quoted Supreme Court standard.

Miscellaneous.—Variable porosity, and unknown position of fissures, in limestone and siliceous shale reservoirs, are some of the additional factors which may occur.

APPLICATION OF GEOLOGICAL FACTORS

The foregoing geological factors which place important limits on knowledge of subsurface reservoir conditions generally affect accumulations of the stratigraphic type. That is, the primary factors governing the disposition of oil in varying amounts within the field are stratigraphic factors. Structure is a regional governing factor which causes the presence of oil at "highs" in the stratigraphic maze rather than elsewhere.

It appears, therefore, that fields of the stratigraphic type are not readily susceptible to allocation based on ownership in place, or, beyond local limits, and with local exceptions, to compulsory control based on engineering estimates of per-acre yield. With the list of such stratigraphic fields headed by Sunset-Midway, with a total production in excess of 780 million barrels of oil, this type of field can not be minimized when legal applications are considered.

A. I. Levorsen, in his presidential address before the American Association of Petroleum Geologists at Tulsa, March 19, 1936,⁹ discussed at length the probable future importance of stratigraphic accumulations. In papers read before the Los Angeles meeting of the Association in March, 1937, Wallace E. Pratt¹⁰ and E. DeGolyer¹¹ both gave further emphasis to the future importance of such fields.

Since, in general, the fields whose reservoir conditions we are able to understand adequately by the application of physics and engineering, are limited to the simple structural types, is it not unwise to formulate on these data, statutes which shall very probably

⁸ R. W. Pack, *op. cit.*, Pl. 37.

⁹ A. I. Levorsen, *op. cit.*

¹⁰ Wallace E. Pratt, "Discovery Ratios in Oil Finding," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 21, No. 6 (June, 1937), p. 704.

¹¹ E. DeGolyer, "Future of Petroleum Exploration in United States," *ibid.*, p. 712.

govern development of the more complex stratigraphic accumulations?

CONFUSION OF ISSUES

Considerable confusion has been caused by the tendency to lump unscientific production methods, waste of natural resources, and bad practice in general, as necessary accompaniments of operation under the rule of capture. As a matter of fact, oil fields can be, and are being, developed in an orderly, scientific manner where the rule of capture prevails.

Further confusion exists because of attempts to use conservation as the basis for drilling and production restrictions. There may be cases where the two are synonymous, but there are also cases where they are not. When an operator ascertains the maximum efficient rate of production to recover the most ultimate oil and to gain the maximum efficient use of reservoir energy, and produces his well on that basis, it is difficult for him to believe that a still further proration to meet some "allowable" is a conservation measure. This attempt to cloud the issue of proration with a conservation camouflage may easily arouse suspicion and antagonism that may become a stumbling block to accomplishing something in the way of stabilization. Northcutt Ely has suggested that it is possible " . . . to control production, for the purpose of stabilization, pure and simple, without regard to conservation."¹²

The distinction between conservation and stabilization is real and important because of its effect on the future. Conservation is permanent; stabilization is temporary. Although there is some question as to *when*, there is little doubt that some day there will be a shortage of oil, and at that time stabilization restrictions will no longer be necessary. It may be safe to prophesy that, when that time comes, the industry will be better off in not being hampered by the legal effects of having today's stabilization statutes rooted in the permanence of true conservation principles.

CONCLUSIONS

Several geological phenomena, all of which occur in actual oil fields, have been mentioned as limiting knowledge of the subsurface disposition of oil in fields principally of the stratigraphic type. It is concluded that the principle of ownership in place is an impossible tenet until such geological problems are solved, because there are

¹² Northcutt Ely, "Legal Restraints on Drilling and Production." Read before the Mineral Section, American Bar Association, September 29, 1937. Published in the *Oil Weekly* (November 29, 1937).

too many unknowns to permit equitable determination of such ownership. Allocation of production and unitization on the theory that surface owners are tenants in common in the ownership of an oil pool is impracticable as regards stratigraphic accumulation because who the tenants are, and where the pool may extend can not be known until the pool is completely drilled.

The real benefits of temporary relief statutes are questionable if conservation is confused with stabilization, and if geological conditions of the type previously mentioned are ignored.

To be effective, any new principle supplanting the rule of capture must offer superior solutions for the geological problems of the type enumerated in this paper.

If statutory regulation of drilling and production, based upon the legal concept of ownership in place, is really necessary at all, it can not be applied generally, but must be limited in application to those fields where physical and engineering data can provide adequate information as to the correct owners of the reservoir fluids.

REVIEWS AND NEW PUBLICATIONS

* Subjects indicated by asterisk are in the Association library and available to members and associates.

RECENT PUBLICATIONS

AFRICA

*"Sur la Structure du Sahara Mauritanien" (On the Structure of the Mauritanian Sahara), by J. Jacquet. *Bull. Soc. Geol. France* (Paris), Fifth Ser., Vol. 7, No. 1-2-3 (1937), pp. 3-8; 1 map.

CANADA

*"Western Canada Possibilities Being Developed Slowly," by Joseph S. Irwin. *Oil and Gas Jour.* (Tulsa), Vol. 36, No. 47 (April 7, 1937), pp. 18-22; 5 figs.

GENERAL

Oil and Petroleum Year Book, 1938, compiled by Walter E. Skinner. 490 pp. "Complete and up-to-date particulars of Producers, Refiners, Transporters, Dealers and Oil Finance Companies operating in all parts of the world." $4\frac{1}{2} \times 7\frac{1}{2}$ inches. Cloth. Walter E. Skinner, 15 Dowgate Hill, London, E. C. 4. Price: 10s. net; abroad, 11s. net.

*"Use of Aerial Photographs in Geologic Mapping," by Wayne Loel. *Min. Tech.* (Amer. Inst. Min. Met. Eng., New York), Vol. 2, No. 2 (March, 1938). 54 pp., 11 figs.

*"The Future of Paleontology," by Joseph A. Cushman. *Bull. Geol. Soc. America* (New York), Vol. 49, No. 3 (March 1, 1938), pp. 359-66; 3 figs.

**Annotated Bibliography of Economic Geology for 1937*, Vol. 10, No. 1 (January, 1938). 234 pp.; 139 titles relating to petroleum geology. Economic Geology Publishing Company, Urbana, Illinois. Price: \$5.00 per year; \$3.00 per number.

*"Résumé of Problems Relating to Edgewater Encroachment in Oil Sands," by F. G. Miller and H. C. Miller. *U. S. Bur. Mines R. I.* 3392 (Washington, D.C., March, 1938). 18 mim. pp.

Physiography of the United States, by Frederick B. Loomis. 350 pp., 212 figs., 1 map. Doubleday, Doran and Company, Inc., Garden City, N.Y. (1938). Price, \$2.75. *Review in *Jour. Geomorphology* (New York), Vol. 1, No. 1 (February, 1938), p. 72.

Landslides and Related Phenomena, by C. F. Stewart Sharpe. 137 pp., 16 figs., 9 pls. Columbia University Press, New York (1937). Price, \$3.00. *Review in *Jour. Geomorphology* (New York), Vol. 1, No. 1 (February, 1937), p. 77.

*"World's Oil Problem and Resources; A Symposium." *Pan-Amer. Geol.* (Des Moines), Vol. 69, No. 3 (April, 1938), pp. 169-207. Discussions presented at the Seventeenth International Geological Congress.

*"Genetic Setting of American Red-beds," by Charles Keyes. *Pan-Amer. Geol.* (Des Moines), Vol. 69, No. 3 (April, 1938), pp. 207-09; 2 figs., 1 table.

GERMANY

*"Eurypteriden aus dem Rheinischen Unterdevon" (Eurypterids of the Lower Devonian of the Rhine), by Leif Störmer. *Abhand. Preuss. Geol. Landesanstalt* (Berlin), New Ser., No. 1 (1936). 74 pp., 12 pls., 10 figs. Published by Prussian National Institution of Geology, Berlin N 4, Invalidenstrasse 44.

*"Bitumenspuren im Ostthüringer Schiefergebirge und im unteren Zechstein" (Asphalt in the East Thuringia Slate Mountains and in the Lower Zechstein), by Rudolf Hundt. *Kali und Erdöl* (Berlin), Jahr. 32, Heft 5 (March 1, 1938), pp. 41-43.

LOUISIANA

*"Geology of Grant and LaSalle Parishes," by H. N. Fisk. *Louisiana Geol. Survey Bull.* 10 (1938). Contains geologic map of each parish; scale, 1:62,500. 50 full-page figures, plates, and folded inserts. List of lower Jackson Mollusca by Wade Hadley. Bibliography by Emma A. Fisk. Conservation Dept., New Orleans.

MEXICO

*"Ammonites of the Taraises Formation of Northern Mexico," by Ralph W. Inlay. *Bull. Geol. Soc. America* (New York), Vol. 49, No. 4 (April 1, 1938), pp. 539-602; 15 pls., 4 figs.

OKLAHOMA

*"Bureau of Mines Analyzes Ramsey Pool, Payne County, Oklahoma, Crude Oil." *U. S. Bur. Mines Press Release 6414* (March 19, 1938). 2 mime. pp.

PALESTINE

*"Wellings' Observations of Dead Sea Structure (with Discussion by Bailey Willis)." *Bull. Geol. Soc. America* (New York), Vol. 49, No. 4 (April 1, 1938), pp. 659-68.

PENNSYLVANIA

"Ground-Water Resources of South-Central Pennsylvania," by Stanley W. Lohman. *Pennsylvania Topog. Geol. Survey* (Harrisburg). Contains description of Paleozoic rocks. Division of Documents, Department of Property and Supplies, Harrisburg.

URUGUAY

*"The Gondwana System of North Eastern Uruguay," by J. D. Falconer. *Instituto de Geologia y Perforaciones Bol.* 23 (Montevideo, February, 1936; published, 1937). 112 pp., 2 geological maps in pocket.

ASSOCIATION DIVISION OF PALEONTOLOGY AND MINERALOGY

**Journal of Sedimentary Petrology* (Tulsa, Oklahoma), Vol. 8, No. 1 (April, 1938).

"Recording the Results of Heavy Mineral Analyses," by Dorothy Carroll

"Studies on the Bacterial Flora of Marine Bottom Sediments," by Claude E. ZoBell

"Sediments of the Submarine Canyons off the California Coast," by George V. Cohee

"Transportation of Sediments on Fresh-Water Surfaces by Flotation," by O. F. Evans

THE ASSOCIATION ROUND TABLE

MEMBERSHIP APPLICATIONS APPROVED FOR PUBLICATION

The executive committee has approved for publication the names of the following candidates for membership in the Association. This does not constitute an election, but places the names before the membership at large. If any member has information bearing on the qualifications of these nominees, he should send it promptly to the Executive Committee, Box 979, Tulsa, Oklahoma. (Names of sponsors are placed beneath the name of each nominee.)

FOR ACTIVE MEMBERSHIP

Gustave Erdman Archie, Greenwich, Kan.
J. M. Wanenmacher, Arnold S. Bunte, L. R. Fortier
Martin Hewett Billings, Houston, Tex.
L. A. Scholl, Jr., John C. Miller, W. W. Patrick
Ralph S. Cooley, Midland, Tex.
R. E. Sherrill, O. C. Harper, Paul D. Torrey
Wesley Philip Cox, Dallas, Tex.
J. E. Elliott, F. C. Merritt, Max L. Krueger
James C. Donnell, II, Findlay, Ohio
C. J. Hares, W. T. Thom, Jr., Frank R. Clark
Paul H. Dudley, Long Beach, Calif.
Frank A. Morgan, H. W. Hoots, Mason L. Hill
Egidio S. Feruglio, Buenos Aires, Argentina, S.A.
A. Rozlosnik, Enrique Fossa-Mancini, Clemens Leidhold
William Davis Frazell, Shreveport, La.
C. C. Clark, Roy T. Hazzard, H. C. Spoor, Jr.
Arthur Gilbertson Hutchison, Point Fortin, Trinidad, B.W.I.
Hans G. Kugler, E. C. Scott, Hollis D. Hedberg
James Albert Lewis, Dallas, Tex.
Lewis W. MacNaughton, J. C. Karcher, E. DeGolyer
William Stokes McCabe, Midland, Tex.
Maria Spencer, Wallace Gordon, J. J. Russell, Jr.
John Robertson McMillan, Bakersfield, Calif.
E. Wayne Galliher, R. W. Sherman, Frank A. Morgan
Carl Edward Moses, Mt. Pleasant, Mich.
B. S. Ridgeway, Raymond S. Hunt, Kurt H. de Cousser
Manley Leonard Natland, Long Beach, Calif.
Frank A. Morgan, H. W. Hoots, Mason L. Hill
Jacob L. Patton, Crowley, La.
L. P. Teas, L. T. Barrow, D. Perry Olcott
James Harold Poteet, Owensboro, Ky.
H. A. Sprowls, George O. Williams, Allen W. Tillotson
Edward Harriman Rainwater, Maracaibo, Venezuela, S.A.
Alfred P. Frey, V. Oppenheim, William S. Hoffmeister
Alfred Senn, Barbados, B.W.I.
Hans G. Kugler, G. H. Scott, Hollis D. Hedberg

(Continued on page 631)

TWENTY-THIRD ANNUAL MEETING
THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
ROOSEVELT HOTEL, NEW ORLEANS, LOUISIANA
MARCH 16-18, 1938

New Orleans, with her proud historic tradition and her delightful blending of modern city life with the romantic, chivalrous hospitality of the deep South, was hostess to the Association on the occasion of the twenty-third annual meeting. A record registration bears witness to the acceptance on the part of the petroleum geologist of the dictum that New Orleans is indeed "America's most interesting city."

Association membership in the Crescent City is limited numerically but is well nigh unlimited dynamically. The few local members, ably headed by Professor R. A. Steinmayer of Tulane University as general committee chairman and heartily supported alike by official and private citizens, worked valiantly for the success that crowned the meeting. It is true that the coöperation of the Shreveport Geological Society and of the South Louisiana Geological Society, domiciled at Lake Charles, was a contributing factor, that the guiding hand of the executive committee was at times stretched forth, and that the unobtrusive but efficient labors of business manager Hull and his staff were felt, but it is to the New Orleans members that the Association's thanks are due for the highly satisfactory results attained in the 1938 meeting.

An auspicious beginning was made through provision by the New Orleans Association of Commerce for the registering of delegates as early as Monday afternoon. Skilled assistants kept the registration desk on the mezzanine functioning throughout the meeting. Toward the close of the convention the Robert L. Steffey Scout Service compiled a complete list of registrants which proved of use to many.

Tuesday, March 15, was given over largely to scheduled meetings of the various Association committees. The executive committee, which had been in session throughout Monday, held a joint meeting with the finance committee and heard several lay members who had special matters to submit for consideration during the morning. In the afternoon the general business committee under the chairmanship of Harold W. Hoots expeditiously disposed of the year's business miscellany. The evening was officially devoted to the research committee's informal dinner which has come to be one of the featured events of the annual meeting. Following the dinner, which was arranged in an impromptu manner in the coffee shop, interested members repaired to the University Room where a colloquium was held on the intriguing subject, "Time of Formation and Accumulation of Petroleum."

The opening session of the three-day meeting was held on Wednesday morning, March 16, in the recently completed Grand Ball Room of the Roosevelt Hotel. Official welcome was extended the Association by the Honorable Jesse S. Cave, Commissioner of Finance of the City of New Orleans, who represented His Excellency, Richard W. Leche, Governor of Louisiana, and His Honor, Robert S. Maestri, Mayor of New Orleans. Past-president Ralph D. Reed in his inimitable way responded to the official welcome and then introduced the Honorable Ernest O. Thompson, member of the Texas Railroad Commission, chairman of the Interstate Oil Compact and favored son of the Lone Star State, who addressed the gathering on the topic, "The Function of Geological and Engineering Science in the Conservation Move-

ment." At the close of Colonel Thompson's spirited discourse president Fuqua was introduced by Professor Henry V. Howe of Louisiana State University and delivered his timely presidential address as the first paper on a lengthy technical program. At the close of the afternoon technical session announcements were made, convention committees were named, and officers for the ensuing year were nominated. As there were no contests the nominees were elected by acclamation. A highly enjoyable feature arranged by the entertainment committee was "A Night on the Mighty Mississippi" when the excursion river-steamer "Capitol," with her cargo of enthralled geologists, dutifully paraded the waterfront until the small hours of morning.

The Society of Exploration Geophysicists conducted its annual meeting on Tuesday and Wednesday, March 15 and 16, the well attended technical sessions being held in the University Room of the Roosevelt Hotel. On Thursday morning a joint technical session was arranged between the American Association of Petroleum Geologists and the affiliated Society of Exploration Geophysicists in which papers by Alexander Deussen and J. C. Karcher were featured. A St. Patrick's Day luncheon was served the ladies in the University Room on Thursday, March 17; then, in order that they might be duly prepared for the festivities of the night, they were conducted on an afternoon walking tour of the Vieux Carré where grilled balconies and secluded courtyards keep fresh the memories of the glamorous days of the old New Orleans. The annual banquet, floor-show, and dinner-dance given that night in the Grand Ball Room furnished elaborate entertainment for a large crowd. A memorable event was the preparation in the suddenly darkened room of great fiery vats of that weird but most palatable concoction *café brûlot* which was served the revelers in after-dinner cups. Many thought that the cups were too small.

Golf was enjoyed by a large number. Unusually handsome trophies were offered by New Orleans citizens and the various hotels. Pairings and times were arranged Wednesday and the tournament was held Thursday at the New Orleans Country Club. The winners were:

Jack Chambers: J. Wallace Bostick trophy, member, low gross.....	79
Nat. W. Bond: J. Wallace Bostick cup, guest, low gross.....	76
Charles M. Rogers: Robert S. Maestri trophy, gross.....	76
Nelson Whitney: Wm. H. McFadden trophy, gross.....	77
E. R. Brockway: Crawford H. Ellis trophy, gross.....	80
Robert H. Lynn: A. B. Paterson trophy, net.....	65
L. C. Smith: Roosevelt Hotel trophy, net.....	67
K. A. Ellison: St. Charles Hotel trophy, net.....	69
J. E. Brown: Monteleone Hotel trophy, nine holes, net.....	31
R. C. Hutchinson: Jung Hotel trophy, nine holes, net.....	32
Elfred Beck: New Orleans Hotel trophy, nine holes, net.....	33
Amis Rich: Coleman E. Adler trophy, kickers, net.....	81
G. Scott Hammond: Charles M. Rogers trophy, kickers, net.....	72
H. A. Hemphill: Walter Adler trophy, kickers, net.....	70

On Friday morning the new officers were introduced in the annual business meeting; they took charge of Association affairs in the joint meeting of the 1937 and 1938 executive committees which followed. In the technical sessions, which were terminated on Friday afternoon, fifty-three papers were presented orally; they were chosen from more than one hundred titles submitted to the technical program committee. Such manifest interest in the dissemination of specialized knowledge on the part of the membership should



Association in technical session, twenty-third annual meeting, Roosevelt Hotel, New Orleans, March 16, 1938. On speakers' platform, left to right: E. O. Thompson, of Interstate Oil Compact; R. A. Steinmayer, chairman of convention general committee; R. D. Reed, past-president; H. B. Fuqua, president; H. V. Howe, secretary-treasurer of Paleontology Division.



Executive committee unanimously elected at New Orleans. Seated, left to right: vice-president Harold W. Hoots, Los Angeles; president Donald C. Barton, Houston; secretary-treasurer Ira H. Cram, Tulsa. Standing, left to right: past-president H. B. Fuqua, Fort Worth; editor W. A. Ver Wiebe, Wichita.

be a source of satisfaction to the editorial board; it augurs well for the future of the *Bulletin*.

The Society of Economic Paleontologists and Mineralogists conducted its technical sessions in the Tip Top Inn on the 12th floor of the hotel. A well rounded program of general interest was presented on Thursday afternoon and Friday morning.

A most eventful social function was the Friday afternoon tea given by Mr. and Mrs. W. H. McFadden in their palatial City Park home. The delightful hospitality of host and hostess amidst the beauty of their estate added the final touch of New Orleans charm to a memorable annual meeting.

Six post-convention field trips were planned for members and guests. New Orleans' geographic location does not permit successful short geological excursions. Therefore the only field events arranged during the progress of the meeting were airplane trips over the lower stretches of the Mississippi delta. Many registrants took advantage of this offering and were delighted with the bird's-eye view of a geosyncline in the making. A two-day trip to view the Oligocene-Miocene formations of Wayne and Smith counties, Mississippi, attracted several able field geologists. Four one-day trips were scheduled for Saturday. Through the courtesy of the Freeport Sulphur Company a large party was conducted to the sulphur mine operated on Grande Ecaille where sulphur mining in all of its phases was explained by company engineers. A delightful luncheon was not the least attraction furnished the guests on this trip. A visit to Avery Island with its famous McIlheney gardens and bird sanctuary as well as a trip into the salt mine provided many members and guests an additional memorable day. The Texas Company and the Louisiana Land and Exploration Company accommodated a large number interested in viewing the development work being carried on in the lakes and bays of the lower Gulf Coast. Oil fields located on or near Highway 90, the "Old Spanish Trail," were visited by a small party under competent guidance. Tentative plans for a field trip to Cuba were made in advance of the meeting, but although inquiries were numerous, insufficient interest was manifested at the registration desk to make the trip possible.

Exhibits of maps, sections, and geological literature appealed to the studious. Geological, geophysical, paleontological, and technological equipment and apparatus were on display and were adequately explained by attendants. Of particular interest was the exhibit of the Louisiana Conservation Commission which stressed the varied industries of the state.

From the time that the arriving delegate read in the entertainment program Mayor Maestri's *bienvenu* until a rap of the gavel closed the last technical session late Friday afternoon, New Orleans was gracious hostess to the petroleum geologist. It may easily be surmised that as each member directed his steps homeward from the twenty-third annual meeting his parting *au revoir* was hummed to the tune "Thanks for the Memories."

C. L. MOODY

NEW OFFICERS

The new officers of the Association, with terms ending with the annual meeting of 1939, were unanimously elected: president, Donald C. Barton, research geologist, Humble Oil and Refining Company, Houston, Texas; vice-president, Harold W. Hoots, chief geologist, Richfield Oil Corporation,

Los Angeles, California; secretary-treasurer, Ira H. Cram (re-elected), district geologist, The Pure Oil Company, Tulsa, Oklahoma; editor, Walter A. Ver Wiebe (re-elected), University of Wichita, Wichita, Kansas.

The newly elected officers of the Division of Paleontology and Mineralogy are: president, E. H. Sellards, director of the University of Texas, Bureau of Economic Geology, Austin, Texas; vice-president, Paul P. Goudkoff, consulting geologist, Los Angeles, California; secretary-treasurer, Henry V. Howe (re-elected), director of the School of Geology, Louisiana State University, Baton Rouge, Louisiana.

The Society of Exploration Geophysicists, an affiliate of the A.A.P.G., elected the following: president, F. M. Kannenstine, Kannenstine Laboratories, Houston, Texas; vice-president, W. T. Born, Geophysical Research Corporation, Tulsa, Oklahoma; secretary-treasurer, H. B. Peacock, Geophysical Service, Inc., Houston, Texas; editor, M. M. Slotnick, Humble Oil and Refining Corporation, Houston, Texas.

CONVENTION REGISTRATION

The total attendance, as recorded at the Association registration counter, was 1,706, the largest A.A.P.G. meeting held in any state outside of Oklahoma. Likewise the attendance of members and associates was the highest of any meeting held outside of Oklahoma. The largest recorded total attendance was 1,847 at Tulsa in 1936. The largest meeting in Texas was 1,454 at Fort Worth in 1929. The attendance of women at New Orleans was the largest in the history of Association meetings. The registrations are classified as follows: active members, 602; associate members, 120; non-member men, 428; non-member women, 556; total, 1,706 (722 members, 984 non-members). The separate registration of the Society of Exploration Geophysicists, brought the grand total of the convention to more than 1,850.

Thirty-five states were represented in the registration. The three leading states were: Texas, 787; Louisiana, 316; Oklahoma, 284. The next eleven were: California, 54; Kansas, 52; Missouri, 24; New York, 21; District of Columbia, 19; Colorado, 18; Illinois, 17; Pennsylvania, 17; Mississippi, 16; Alabama, 8; Arkansas, 8.

EXECUTIVE COMMITTEE

The executive committee of the Association during the year ended with the twenty-third annual meeting, March, 1938, were: H. B. Fuqua, chairman; Ira H. Cram, secretary; R. D. Reed, C. L. Moody, and W. A. Ver Wiebe.

SHREVEPORT DISTRICT

The Shreveport Geological Society and the Lake Charles Geological Society sponsored the annual meeting at New Orleans. The officers of the Shreveport society are: president, B. W. Blanpied; vice-president, E. B. Hutson; secretary-treasurer, J. D. Aimer. The officers of the Lake Charles society are: president, John F. Mahoney; vice-president, Dean F. Metts; secretary, W. R. Canada; treasurer, Baker Hoskins.

CONVENTION COMMITTEES

General.—R. A. Steinmayer, chairman; Richard W. Leche, Robert S. Maestri, William G. Rankin, C. L. Moody, B. W. Blanpied, C. I. Alexander, Pierce Cline, Harold A. Gaudin, Rufus C. Harris, James M. Smith, J. A. Shaw, H. V. Howe, Ben J.

Williams, M. A. Dyer, J. A. Bechtold, Wilson T. Lundy, W. H. McFadden, J. E. Ralston, J. C. Munroe, H. G. Meador.

Technical Program.—C. L. Moody, chairman; H. V. Howe, vice-chairman; M. M. Albertson, C. I. Alexander, Wm. A. Baker, Jr., John G. Bartram, Alfred H. Bell, Charles B. Carpenter, Ira H. Cram, M. G. Edwards, M. Gordon Gulley, R. T. Hazzard, Hollis D. Hedberg, J. F. Hosterman, Wm. E. Hubbard, A. M. Lloyd, John C. Miller, H. D. Miser, Stuart Mossom, W. C. Spooner, W. A. Ver Wiebe.

Reception.—C. I. Alexander, chairman; F. W. Bates, H. L. Burchfiel, John Doering, C. M. Dorchester, R. B. Grigsby, R. M. Harris, J. L. Henning, Philip H. Jennings, G. E. Laskey, H. V. Tygrett.

Registration.—John F. Mahoney, chairman.

Hotels.—J. Edward Lytle, chairman; W. R. Canada, U. B. Hughes, H. E. McGlasson, Willard M. Payne, R. D. Russell, H. K. Shearer, L. B. Smith, H. N. Toler.

Entertainment.—Carroll E. Cook, chairman; W. M. Barret, S. P. Borden, V. P. Grage, S. G. Gray, L. S. Harlowe, W. K. Link, A. M. Lloyd, J. F. Mahoney, L. R. McFarland, E. H. Thaete, M. E. Wilson.

Finance.—R. A. Steinmayer, chairman; E. L. Caster, C. C. Clark, C. R. McKnight, George W. Schneider, G. D. Thomas.

Publicity.—C. K. Moresi, chairman; H. W. Bell, Geo. C. Branner, W. F. Chisholm, A. F. Crider, Preston Fergus, D. E. Fuellhart, Herman Gunter, Baker Hoskins, Walter B. Jones, D. J. Munroe.

Field Trips.—Roy T. Hazzard, chairman; B. W. Blanpied, Martin N. Broughton, Robert B. Campbell, R. B. Grigsby, Urban B. Hughes, James H. McGuirt, R. H. Palmer, C. J. Roy, Paul T. Seashore, E. H. Thaete, Jr.

Transportation.—Tatham R. Eskrigge, chairman; E. D. Klinger, R. L. McLaren, S. A. Packard, R. G. Ryan, W. C. Spooner, E. A. Stiller, W. B. Weeks.

Golf.—Donald Goodwill, Jr., chairman; L. A. Barton, S. P. Borden, Everett Eaves, A. M. Lloyd, L. G. Welsh.

LADIES

Mrs. R. A. Steinmayer, *chairman*

New Orleans members.—Mrs. Carroll E. Cook, Mrs. Tatham R. Eskrigge, Mrs. Edward J. Lytle, Mrs. W. H. McFadden, Mrs. C. K. Moresi, Mrs. E. H. Thaete, Jr.

State of Louisiana members.—Mrs. B. W. Blanpied, Mrs. C. I. Alexander.

Association members.—Mrs. H. B. Fuqua, Mrs. C. L. Moody, Mrs. Ira H. Cram, Mrs. Ralph D. Reed.

SCHEDULE OF EVENTS

All meetings were in the Roosevelt Hotel.

MONDAY, MARCH 14

- 2:00 P.M. Registration. Mezzanine
7:00 P.M. Executive committee, H. B. Fuqua, chairman

TUESDAY, MARCH 15

- 8:00 A.M. Registration. Mezzanine
Nominating committee and executive committee, Society of Exploration Geophysicists
9:00 A.M. Committee on application of geology, Frank R. Clark, chairman
10:00 A.M. (a) Technical session, Society of Exploration Geophysicists. University Room
(b) Executive committee and finance committee
(c) Committee for publication, F. H. Lahee, chairman
11:00 A.M. Research committee, Donald C. Barton, chairman
12:15 P.M. Luncheon. Society of Exploration Geophysicists. Blue Room
2:00 P.M. (a) Business committee, Harold W. Hoots, chairman
(b) Technical session, Society of Exploration Geophysicists. University Room
6:30 P.M. Informal dinner for geologists and ladies, sponsored by research committee, followed by round-table discussion of "Time of Formation and Accumulation of Petroleum." University Room
8:00 P.M. Banquet, Society of Exploration Geophysicists. Grand Ball Room

WEDNESDAY, MARCH 16

- 9:00 A.M. Registration. Mezzanine
Opening general session. Address of welcome by the Honorable Richard W. Leche, Governor, State of Louisiana. Response by R. D. Reed. Address by Col. E. O. Thompson. Grand Ball Room
- 9:30 A.M. General technical session. Grand Ball Room
- 10:00 A.M. Technical session, Society of Exploration Geophysicists. University Room
- 1:30 P.M. General technical session. Grand Ball Room
- 2:00 P.M. Technical session, Society of Exploration Geophysicists. University Room
- 4:45 P.M. Announcements, nomination of officers, appointment of committees. General Session. Grand Ball Room
- 7:30 P.M. "A Night on the Mighty Mississippi." Steamer "Capitol" at foot of Canal Street

THURSDAY, MARCH 17

- 8:00 A.M. Committee on geologic names and correlations, J. G. Bartram, chair man
Breakfast meeting
- 9:00 A.M. General technical session. Joint meeting with the Society of Exploration Geophysicists. Grand Ball Room
- 12:30 P.M. (a) College, fraternity, company, and organization luncheons
(b) Ladies entertainment. St. Patrick's Day luncheon. University Room
- 1:00 P.M. J. Wallace Bostick golf tournament. New Orleans Country Club
- 1:30 P.M. (a) General technical session. Grand Ball Room
(b) Technical session, Society of Economic Paleontologists and Mineralogists. Tip Top Inn
- 2:30 P.M. Ladies tour of Vieux Carré
- 3:30 P.M. Annual business meeting, Society of Economic Paleontologists and Mineralogists. Tip Top Inn
- 7:30 P.M. Dinner-dance. Grand Ball Room

FRIDAY, MARCH 18

- 9:00 A.M. Twenty-third annual business meeting. Grand Ball Room. Announcement of elections
- 10:00 A.M. (a) Executive committees, joint meeting 1937 and 1938 committees
(b) General technical session. Grand Ball Room
(c) Technical session, Society of Economic Paleontologists and Mineralogists. Tip Top Inn
- 1:30 P.M. General technical session. Grand Ball Room
- 2:30 P.M. Field trip to Wayne and Smith counties, Mississippi (two days)
- 4:00 P.M. Ladies tea. Courtesy of Mrs. W. H. McFadden, Center City Park

SATURDAY, MARCH 19

- 7:00 A.M. Field trip. Gulf Coast drilling operations. By courtesy of The Texas Company and the Louisiana Land and Exploration Company
- 8:00 A.M. Field trips
(a) Sulphur Mine, Lake Washington, courtesy Freeport Sulphur Company (one day)
(b) Avery Island salt mine (one day)
(c) Gulf Coast oil fields (one day)

TECHNICAL PROGRAM

I. GENERAL PAPERS DELIVERED ORALLY

1. H. B. FUQUA (Gulf Oil Corporation, Fort Worth, Texas), presidential address: Future of the Geologist in the Petroleum Industry
2. F. H. LAHEE (Sun Oil Company, Dallas, Texas): Wildcat Drilling in 1937
3. J. E. POGUE (Chase National Bank, New York City): Economic Aspects of Drilling
4. N. H. DARTON (U. S. Geological Survey, retired, Washington, D. C.): Tectonics of the Southwest

5. GEORGE A. WILSON (College of Law, Tulane University, New Orleans, Louisiana):
Rôle of the Petroleum Geologist in the Development of the Law of Oil and Gas
6. WARREN B. WEEKS (Phillips Petroleum Company, El Dorado, Arkansas):
South Arkansas Stratigraphy with Special Emphasis on the Older Coastal
Plain Beds
7. LLOYD W. STEPHENSON and JOHN B. REESIDE, JR. (U. S. Geological Survey,
Washington, D. C.): A Comparison of the Upper Cretaceous Deposits of the
Gulf Region and the Western Interior Region
8. C. C. CLARK, A. F. CRIDER, V. P. GRAGE, R. T. HAZZARD, E. B. HUTSON, H. R.
KAMB, S. A. PACKARD, G. D. THOMAS, E. F. WARREN (Shreveport, Louisiana):
Résumé of Certain Cretaceous Fields of Louisiana
9. B. W. BLANPIED and ROY T. HAZZARD (Gulf Refining Company, Shreveport,
Louisiana): Stratigraphic Relations of the Limestone Creek Group, Wayne
County, Mississippi
10. URBAN B. HUGHES (Laurel Oil and Gas Company, Laurel, Mississippi): De-
tailed Study of Bucatunna-Vicksburg Contact in Smith County, Mississippi
11. CHALMER J. ROY (Louisiana State University, Baton Rouge, Louisiana): Type
Locality of the Citronelle Formation, Citronelle, Alabama
12. L. W. STEPHENSON and W. H. MONROE (U. S. Geological Survey, Washington,
D. C.): Stratigraphy of the Upper Cretaceous Series in Mississippi and Alabama
13. DONALD W. GRAVELL and MARCUS A. HANNA (Gulf Oil Corporation, Houston,
Texas): Tertiary Zones of Correlation through Mississippi, Alabama and
Florida
14. J. M. FROST, III (University of Texas, Austin, Texas): Geologic Aspects of Heav-
ing Shales on the Texas Coast
15. JOHN L. RICH (University of Cincinnati, Cincinnati, Ohio): Graben Faulting and
Associated Phenomena
16. PAUL H. PRICE (State Geologist of West Virginia) and A. J. W. HEADLEE (Mor-
gantown, West Virginia): Regional Variations in the Composition of Natural
Gas in the Appalachian Province
17. T. V. MOORE (Humble Oil and Refining Company, Houston, Texas): Behavior of
Fluids in Oil Reservoirs
18. FRANK G. MILLER and H. C. MILLER (U. S. Bureau of Mines, San Francisco,
California): Résumé of Problems Relating to Edgewater Encroachment in Oil
Sands
19. JOHN S. IVY (Union Producing Company, Houston, Texas): Rodessa Oil Field
20. W. ARMSTRONG PRICE (Corpus Christi, Texas): Comparisons of Gulf Coast and
Appalachian Geosynclines
21. CARROLL E. COOK (Humble Oil and Refining Company, New Orleans, Louisiana):
Darrow Salt Dome, Ascension Parish, Louisiana
22. J. C. KARCHER (Geophysical Service, Inc., Dallas, Texas): Review of Relations
between Physics and Geology
23. ALEXANDER DEUSSEN (Houston, Texas): Discoveries
24. C. WYTHE COOKE and ARTHUR C. MUNYAN (Washington, D. C., and Atlanta,
Georgia): Stratigraphy of the Coastal Plain of Georgia
25. PHILIP B. KING (U. S. Geological Survey, Washington, D. C.): Paleogeography
and Correlation of West Texas Permian
26. ADDISON YOUNG, MAX DAVID, and E. A. WAHLSTROM (Landreth Production
Company, Fort Worth, Texas): Geology of the Goldsmith Pool, Texas
27. C. E. DOBBIN (U. S. Geological Survey, Denver, Colorado): Geologic Structure
of Part of Petroleum Reserve No. 7, Washington County, Utah
28. HAL P. BYBEE (Bureau of Economic Geology, Austin, Texas): Possible Nature
of Some Limestone Reservoirs in the South Permian Basin
29. F. B. PLUMMER (University of Texas, Austin, Texas) and R. C. MOORE (Uni-
versity of Kansas, Lawrence, Kansas): Stratigraphy and Structure of the
Older Carboniferous Rocks on the Llano Uplift in Central Texas
30. ROBERT H. CUYLER (University of Texas, Austin, Texas): Travis Peak Formation
of Central Texas
31. CLARK MILLISON (Tulsa, Oklahoma): Subsurface Study of the North Flank of
the Wichita Mountains, Oklahoma
32. E. J. BARTOSH (Bankline Oil Company, Los Angeles, California): Wilmington
Oil Field, California

33. J. R. LOCKETT (Ohio Fuel Gas Company, Columbus, Ohio): Structural Significance of the Cincinnati Arch
34. KENDALL E. BORN (Tennessee Division of Geology, Nashville, Tennessee): A Lower Ordovician Sand Horizon ("St. Peter") in Middle Tennessee
35. GEORGE S. BUCHANAN (Adams Oil and Gas Company, Houston, Texas): Cheneyville Oil Field, Rapides Parish, Louisiana, and Its Relation to the Areas of Mother Salt Deposition

SYMPOSIUM ON RECENT AND CURRENT DEVELOPMENTS

36. ALFRED H. BELL (Oil and Gas Division, Illinois State Geological Survey, Urbana): Recent Petroleum Development in Illinois
37. CARL C. ADDISON (Pure Oil Company, Saginaw, Michigan): The Buckeye Oil Field, Michigan
38. RYCROFT G. MOSS (Phillips Petroleum Company, Wichita, Kansas): Developments in Kansas, 1937
39. EDWIN H. HUNT (The Texas Company, Denver, Colorado): Rocky Mountain Area
40. HAL P. BYBEE and BERT E. HAIGH (Bureau of Economic Geology, Austin, Texas): Summary of Petroleum Development in West Texas and South-eastern New Mexico During 1937
41. HAROLD W. HOOTS (Richfield Oil Corporation, Los Angeles, California): Discoveries in California during 1937
42. H. K. SHEARER (The Hunter Company, Shreveport, Louisiana): Oil and Gas Development in South Arkansas and North Louisiana in 1937
43. E. A. WENDLANDT (Humble Oil and Refining Company, Tyler, Texas) and C. L. HEROLD (Shell Petroleum Corporation, Tyler, Texas): Résumé of Development During 1937 in the East Texas District
44. O. L. BRACE (Houston, Texas): Gulf Coastal Developments in 1937
45. STUART MOSSOM (Magnolia Petroleum Company, San Antonio, Texas): 1937 Activities in South Texas
46. BASIL B. ZAVOICO (Chase National Bank, Houston, Texas): Russian Developments in 1937

GENERAL

47. H. B. STENZEL (Bureau of Economic Geology, Austin, Texas): The Yegua Problem
48. F. B. PLUMMER (Bureau of Economic Geology, Austin, Texas): Oil Reservoirs
49. ALEXANDER DEUSSEN and KENNETH DALE OWEN (Houston): Correlation of Surface and Subsurface Formations in Two Typical Sections of the Gulf Coast
50. RALPH E. TAYLOR (Freeport Sulphur Company, New Orleans): Salt-Dome Terminology
51. HENRY N. TOLER (Mississippi State Oil and Gas Supervisor, Jackson, Mississippi) and WATSON H. MONROE (U. S. Geological Survey, Washington, D. C.): Jackson Gas Field and the State Deep Test Well
52. D. J. MUNROE (Sun Oil Company, Hattiesburg, Mississippi): Scanlan, or Midway, Salt Dome, Lamar County, Mississippi
53. W. ARMSTRONG PRICE (Corpus Christi, Texas): Geology of Rio Grande Delta, Texas and Mexico, Interpreted by Geomorphology and Soils

II. GENERAL ASSOCIATION PAPERS DELIVERED BY TITLE

54. E. A. NEWMAN (Michigan Geological Survey, Lansing, Michigan): Recent Developments in the Michigan Basin
55. MERLE C. ISRAELSKY (Union Producing Company, Houston): Cretaceous and Late Comanche Stratigraphy of the Arkansas-Louisiana-East Texas Area
56. C. C. CLARK (Union Producing Company, Shreveport): Sugar Creek Field, Louisiana
57. A. F. CRIDER (Shreveport): Bellevue Oil Field
58. V. P. GRAGE and E. F. WARREN (Gulf Refining Company, Shreveport): Lisbon Oil Field, Claiborne and Lincoln Parishes, Louisiana
59. R. T. HAZZARD (Gulf Refining Company, Shreveport) and A. M. LLOYD (Sun Oil Company, Shreveport): Résumé of Louisiana Upper Cretaceous Fields
60. H. R. KAMB (Arkansas Fuel Oil Company, Shreveport): Bear Creek, Driscoll, and Simsboro Gas Fields, Bienville and Lincoln Parishes, Louisiana

61. S. A. PACKARD (Arkansas Fuel Oil Company, Shreveport): Sligo Field, Bossier Parish, Louisiana
62. G. D. THOMAS (Shell Petroleum Corporation, Shreveport): Cartersville-Sarepta and Shongaloo Fields, Bossier and Webster Parishes, Louisiana
63. E. B. HUTSON (Standard Oil Company of Louisiana, Shreveport): Cotton Valley Field, Webster Parish, Louisiana
64. C. I. ALEXANDER (Magnolia Petroleum Company, Lake Charles, Louisiana), A. M. LLOYD (Sun Oil Company, Shreveport), and R. T. HAZZARD (Gulf Refining Company, Shreveport): North-South Geologic Cross Section Through Southwestern Arkansas and Western Louisiana
65. B. W. BLANPIED (Gulf Refining Company, Shreveport): Age and Correlation of the Salt Mountain Limestone, Clarke County, Alabama
66. A. C. MUNYAN (Assistant State Geologist of Georgia, Atlanta, Georgia): Recent Petroleum Activities in the Coastal Plain of South Georgia
67. OLIVE C. POSTLEY (U. S. Geological Survey, Washington, D. C.): Oil and Gas Possibilities of the Atlantic Coastal Plain from New Jersey to Florida
68. HARVEY WHITAKER (Bridwell Oil Company, San Antonio, Texas): Hoffman Field, Duval County, Texas
69. C. L. MOODY (The Ohio Oil Company, Shreveport): Earlier Mesozoic History of the Northern Gulf Region
70. STANLEY C. HEROLD (Shell Oil Company, Los Angeles): Criteria for Determination of Time of Accumulation under Special Circumstances
71. W. BAXTER BOYD (Continental Oil Company, Ponca City, Oklahoma): Jesse Pool, Pontotoc and Coal Counties, Oklahoma
72. ALLEN W. TILLOTSON (Tulsa, Oklahoma): Olympic Pool, Hughes and Okfuskee Counties, Oklahoma
73. T. C. HESTAND (Indian Territory Illuminating Oil Company, Bartlesville, Oklahoma): Studies of Insoluble Residues from the "Mississippi Lime" of Central Kansas
74. R. L. DENHAM (Humble Oil and Refining Company, Midland, Texas): Means Field, Andrews County, Texas
75. GLENN G. BARTLE (University of Kansas City, Kansas City, Missouri): Cherokee Formation Near Kansas City
76. SAMUEL G. LASKY (U. S. Geological Survey, Washington, D. C.): A Newly Discovered Section of Trinity Age in Southwestern New Mexico
77. C. LATHROP HEROLD (Shell Petroleum Corporation, Tyler, Texas): Geology of the Salinas and Jamesburg Quadrangles, Monterey County, California
78. B. W. BLANPIED and ROY T. HAZZARD (Gulf Refining Company, Shreveport): Structure and Stratigraphy of the Hatchetigbee Anticline and Jackson Fault Areas, Alabama
79. W. ARMSTRONG PRICE (Corpus Christi, Texas): Tentative Correlation of Gulf Coast and Mississippi Valley Pleistocene Deposits
80. ARTHUR G. HUTCHISON (United British Oilfields of Trinidad, Ltd., Point Fortin, Trinidad, British West Indies): Upper Eocene Unconformity of Trinidad
81. FREDERIC A. BUSH (Sinclair-Prairie Oil Company, Tulsa): Geology of the Moore Field, Cleveland County, Oklahoma
82. WARREN B. WEEKS and CLYDE W. ALEXANDER (Phillips Petroleum Company, El Dorado, Arkansas): Schuler Field, Union County, Arkansas
83. R. G. REESE (Standard Oil Company of California, Los Angeles): El Segundo Oil Field, California
84. M. KAMEN KAYE (Caracas Petroleum Corporation, Ciudad Bolivar, Venezuela): Review of Problems in the Geological Succession of Venezuela
85. GORDON ATWATER (Skelly Oil Company, Houston): Isopach Contouring of Faulted Formations
86. ROLLIN ECKIS (Richfield Oil Company, Bakersfield, California): Significance of Stratigraphic Distribution of Recent Oil and Gas Discoveries in the San Joaquin Valley of California
87. LON B. TURK (Oklahoma City, Oklahoma): A Study of Minor Folds: Their Relation to Production and the Major Structures
88. H. M. HORTON (The Superior Oil Company, Houston): Bosco Oil Field, Acadia and St. Landry Parishes, Louisiana Gulf Coast
89. J. BRIAN EBY (Sterling Building, Houston): Relation of Geological and Geophysical Exploration to Discoveries and Reserves

90. CLAUDE C. ALBRITTON, JR. (Southern Methodist University, Dallas): Summary of Results of a Geological Survey in the Malone Mountain Area, Hudspeth County, Texas
91. ROBERT ROTH (Humble Oil and Refining Company, Wichita Falls, Texas): Triassic Period in the United States
92. J. ELMER THOMAS (Houston): The Soviet Method of Estimating Oil Reserves
93. H. L. RAU and K. A. ACKLEY (Carter Oil Company, Seminole, Oklahoma): Geology and Development of the Keokuk Pool, Seminole and Pottawatomie Counties, Oklahoma
94. GEORGE H. NORTON (Atlantic Refining Company, Wichita, Kansas): Permian Red Beds of Kansas
95. ROY H. HALL (Wichita): History of Central Kansas Uplift
96. MARVIN TAYLOR and JOHN L. GARLOUGH (Wichita): Geology of Southwest Kansas Gas Area
97. F. W. DEWOLF (Professor of Geology, University of Illinois, Urbana) and W. W. WEST (Skelly Oil Company, Midland, Texas): Stratigraphic Studies of the Baker-Glendive Anticline, Eastern Montana
98. W. T. NIGHTINGALE (Mountain Fuel Supply Company, Rock Springs, Wyoming): Petroleum and Natural Gas in Non-Marine Sediments of the Powder Wash Field in Northwest Colorado
99. W. D. ANDERSON and JAMES R. DAY (Amerada Petroleum Corporation, Midland, Texas): Monument Field, Lea County, New Mexico
100. PHIL F. MARTYN (Houston Oil Company, Houston): Refugio Oil and Gas Field, Refugio County, Texas

III. SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

1. M. P. WHITE (Gulf Oil Corporation, Ardmore, Oklahoma): A Common Language
2. BROOKS F. ELLIS (New York University, New York City): A Catalogue of Foraminifera
3. R. DANA RUSSELL and LEO W. HOUGH (Louisiana State University, Baton Rouge): A Test of Petrographic Correlation of Oil Sands in the Gulf Coast
4. M. E. UPSON (Gulf Oil Corporation, Fort Worth, Texas): Pre-Pennsylvanian Stratigraphy and Microfauna of the Deep Wells of West Texas
5. CHARLES E. DECKER (University of Oklahoma, Norman): Preliminary Paper on *Didymograptus Protobifidus* in North America
6. CHARLES E. DECKER (University of Oklahoma, Norman): *Didymograptus Protobifidus*, Its Transients and Related Forms in the Upper Arbuckle Limestone of Oklahoma
7. H. H. BRADFIELD (The Texas Company, Fort Worth, Texas): New Texas Fusulinidae
8. H. H. BRADFIELD (The Texas Company, Fort Worth): Notes on Fusuline Morphology
9. CHARLES E. DECKER (University of Oklahoma, Norman): A Pneumatocyst on the Synrhabdosomes of *Monograptus* (*Linograptus*) *Phillipsi* Multiramosus from the Henryhouse Shale (Silurian) of Oklahoma
10. CHARLES E. DECKER (University of Oklahoma, Norman): A Eurypterid from the Wellington Shale (Lower Permian) Near Red Rock, Oklahoma
11. R. C. MOORE (University of Kansas, Lawrence, Kansas) and F. B. PLUMMER (University of Texas, Austin, Texas): Upper Carboniferous Crinoids from the Morrow Subseries of Arkansas, Oklahoma, and Texas
12. R. W. HARRIS and DON VIEAUX (University of Oklahoma, Norman): Ostracoda Common to the Carboniferous of the British Isles and the Pennsylvanian of Oklahoma
13. HUGH ELEY (University of Oklahoma, Norman): Paleontology of the Big Bend Region of Brewster County, Texas
14. J. B. GARRETT (Stanolind Oil and Gas Company, Houston): The Hackberry Assemblage—An Interesting Foraminiferal Fauna of Post-Vicksburg Age from Deep Wells in the Gulf Coast.
15. J. WILLIS STOVALL (University of Oklahoma, Norman): Additional Discoveries of *Cotylorhynchus Romeri*

16. J. WILLIS STOVALL and WILLIAM McANULTY (University of Oklahoma, Norman): A New Pliocene Fish Deposit in Oklahoma
17. J. WILLIS STOVALL and DON E. SAVAGE (University of Oklahoma, Norman): Recent Discoveries of Phytosaurs on the Cimarron River, Union County, New Mexico
18. STANLEY G. WISSLER (Union Oil Company of California, Compton, California): The Application of Numerical Abundance and Faunal Assemblage for Sub-surface Correlation

IV. SOCIETY OF EXPLORATION GEOPHYSICISTS

1. S. S. WEST (Subterrex, Houston): Electrical Prospecting with Non-Sinusoidal Alternating Currents
2. J. J. JAKOSKY (International Geophysics, Los Angeles): Continuous Electrical Profiling
3. PAUL F. HAWLEY (Western Geophysical, Los Angeles): Transients in Electrical Prospecting
4. H. M. EVJEN (Shell Petroleum Corporation, Houston): Depth Factors and Resolving Power of Electrical Measurements
5. G. H. MURRAY, M. MARTIN, and W. J. GILLINGHAM (Schlumberger Well Surveying Corporation, Houston): Determination of Potential Productivity of Oil-Bearing Formations by Resistivity Measurements
6. DANIEL SILVERMAN (Western Geophysical Company, Los Angeles): The Steady-State Response of Electro-Magnetically-Damped Dynamic and Reluctance-Type Seismometers
7. ROLAND F. BEERS (Geotechnical Corporation, Dallas): A Problem in Seismic Depth Calculation
8. RAYMOND T. CLOUD (Western Geophysical, Los Angeles): The Energy and Amplitude of Reflected Seismic Waves
9. CECIL H. GREEN, T. N. WALSH, and BARNEY FISHER (Geophysical Service, Dallas): Velocity-Depth Determinations from Velocity Profiles
10. MORTON MOTT-SMITH (Independent Exploration, Houston): On Seismic Paths and Velocity-Time Relations
11. S. M. ROCK (Rieber Laboratory, Los Angeles): Three-Dimensional Reflection Control
12. CURTIS H. JOHNSON (Rieber Laboratory, Los Angeles): Steady-State Polar Sensitivity Curves
13. MAURICE EWING and A. J. HOSKINSON (Lehigh University, Bethlehem, Pennsylvania): Vertical Gradient of Gravity
14. E. A. ECKHARDT (Gulf Research and Development Corporation, Pittsburgh): Gravity-Difference Benchmarks for Gravimeter Calibration and Control Thereof
15. H. KLAUS (Klaus Exploration Company, Enid): An Introduction to the Second Derivative Contour Method of Interpreting Torsion-Balance Data
16. REED LAWLOR (Rieber Laboratory, Los Angeles): Chart for Dip Computations
17. DUNFORD KELLY (Western Geophysical, Los Angeles): A Reaction-Type Steady-State Shaking Table
18. E. D. LYNTON (Standard Oil Company of California, Los Angeles): Further Development in Laboratory Orientation of Well Cores by Their Magnetic Polarity
19. NEIL R. SPARKS and PAUL F. HAWLEY (Western Geophysical, Los Angeles): Maximum Electromagnetic Damping of a Reluctance Seismometer
20. Z. A. MITERA (Lwow, Poland): Present Status and Future Aspects of Geophysical Prospecting in Poland
21. GEORGE C. MCGHEE (National Geophysical Company, Dallas): A Seismic Survey in the South of England
22. MORRIS MUSKAT (Gulf Research and Development Corporation, Pittsburgh): The Reflection of Longitudinal Wave Pulses from Plane-Parallel Plates
23. E. E. ROSAIRE (Subterrex, Houston): Shallow Stratigraphic Variations over Gulf Coast Structures
24. KING M. HUBBERT (Columbia University, New York): The Status of Geophysics in a Department of Geology
25. C. S. PIGGOTT (Geophysical Laboratory, Carnegie Institution, Washington, D. C.): Ocean-Bottom Core Apparatus and the Results from Some Cores

MINUTES, TWENTY-THIRD ANNUAL BUSINESS MEETING
ROOSEVELT HOTEL, NEW ORLEANS, LOUISIANA
MARCH 16-18, 1938

H. B. FUQUA, *presiding*

The meeting was called to order at 4:45 P.M., March 16, 1938, by H. B. Fuqua, president, Ira H. Cram serving as secretary.

1. *Nominations of officers.*—The president called for nominations of officers of the Association for the ensuing year. The following nominations were made.

For president: DONALD C. BARTON, nominated by M. G. Cheney

For vice-president: HAROLD W. HOOTS, nominated by A. R. Denison

For secretary-treasurer: IRA H. CRAM, nominated by Charles H. Row

For editor: W. A. VER WIEBE, nominated by W. T. Thom

There being only one nominee for each office, motion was made, seconded, and carried that the secretary be authorized to cast a unanimous ballot for each nominee.

2. *Resolutions committee.*—Alexander Deussen, chairman, C. R. McCollom, and A. I. Levorsen were appointed by the president as a committee on resolutions.

The meeting was recessed at 5:00 P.M. until 9:15 A.M., March 18, 1938.

The recessed meeting was called to order at 9:15 A.M., March 18, 1938, by H. B. Fuqua, president.

3. *Reading of minutes.*—It was moved, seconded, and carried that the reading of the minutes of the annual meeting held at Los Angeles, California, March 17-19, 1937, be dispensed with, inasmuch as they had been published in the *Bulletin*.

4. *Report of officers.*—The reports of president H. B. Fuqua, editor W. A. Ver Wiebe, and secretary-treasurer Ira H. Cram were presented (Exhibits I, II, and III).

5. *Report of business committee.*—The report of the business committee (Exhibit IV) was read by the chairman, Harold W. Hoots. It was moved, seconded, and carried that the recommendations contained therein be adopted. (The reports of the committee on geologic names and correlations, John G. Bartram, chairman; of the research committee, Donald C. Barton, chairman; of the committee on applications of geology, Frank R. Clark, chairman; of the committee for publication, F. H. Lahee, chairman; and of the representative of the Association on the National Research Council Division of Geology and Geography, F. H. Lahee, representative, appear as Exhibits V, VI, VII, VIII, and IX, respectively.)

6. *Report of resolutions committee.*—The report of the resolutions committee (Exhibit X) presented by Alexander Deussen, chairman, was unanimously adopted.

7. Alexander Deussen suggested that something be done to increase the attendance of the annual business meeting. Suggestions were made to hold the meeting in the afternoon, and to change the night of the annual dinner-dance to the last night of the meeting.

8. Berte R. Haigh read the following resolution presented by the West Texas Geological Society. It was moved, seconded, and carried that the resolution be referred to the executive committee.

*The Executive Committee
American Association of Petroleum Geologists*

GREETINGS:

WHEREAS, There has not been a technical session of the American Association of Petroleum Geologists held in the West Texas area in the past seven years; and

WHEREAS, There is a very large number of young geologists now working in the West Texas area to whom the annual meetings of the Association have not been available, and probably will not be in the near future, but to whom a sectional meeting would be available and a decided advantage; and

WHEREAS, There are a large number of these young geologists who are potential members of the Association; and

WHEREAS, El Paso, Texas, is located approximately midway between Los Angeles and Tulsa, thus being accessible to members from a widespread area; and

WHEREAS, Investigation has shown that El Paso has ample hotel facilities to take care of those who would be expected to attend a fall meeting of the Association; and

WHEREAS, El Paso is so situated that a great variety of field trips can be arranged both in Old Mexico and in the United States some of which would have considerable bearing upon the present stratigraphic problems of West Texas development; and

WHEREAS, A canvass of the territory has indicated that approximately fifteen technical papers can be secured; and

WHEREAS, The El Paso chapter of the A.I.M. & M.E., the New Mexico Geological Society, the South Texas Geological Society, the El Paso Chamber of Commerce, the Carlsbad, New Mexico, Chamber of Commerce, the Midland, Texas, Chamber of Commerce, the College of Mines and Metallurgy of The University of Texas, and the New Mexico School of Mines have all agreed to cooperate to the fullest extent to make a fall meeting of the American Association of Petroleum Geologists a credit to the Association and of great benefit to the Association and its members;

Therefore, The West Texas Geological Society respectfully requests that the executive committee of the American Association of Petroleum Geologists grant to the West Texas Geological Society the authority to sponsor and direct a fall meeting of the American Association of Petroleum Geologists at El Paso, Texas, September 27 to October 2, 1938, both dates inclusive, it being agreed that the dates September 27 and 28 and October 1 and 2 would be devoted to field trips.

Respectfully submitted to the executive committee of the American Association of Petroleum Geologists in convention assembled at New Orleans, Louisiana, March, 1938.

WEST TEXAS GEOLOGICAL SOCIETY
H. A. Hemphill, *president*

9. *Introduction of new officers.*—The newly elected officers of the Association were introduced by retiring president Fuqua.

On motion by Harry W. Osborne a rising vote of thanks was tendered to the outgoing executive committee in appreciation of their work for the Association.

The twenty-third annual business meeting adjourned at 10:00 A.M.

H. B. FUQUA, *president*

IRA H. CRAM, *secretary*

EXHIBIT I. REPORT OF PRESIDENT

(Year Ending March 18, 1938)

The purpose of this report is to bring before the members several matters of general interest to the Association, at the same time avoiding, so far as possible, a repetition of points to be covered by the editor, Dr. W. A. Ver Wiebe, and the secretary-treasurer, Mr. Ira H. Cram, who have more readily at hand the details of their offices. However, it is in order at this point to state that a new all-time peak in membership has been reached by the Association

and that its financial affairs are regarded by the executive committee as being in a most satisfactory condition. Further, the difficulty experienced during the past several years in securing a sufficient number of desirable papers to take care of *Bulletin* requirements has apparently been overcome.

This healthy state of affairs is in part due to generous contributions from the membership of the various sections, divisions, and affiliated societies, made available after their several meetings and, in greater part, to the efforts of the committee for publication which was formed during the past year following the suggestion made by past-president Ralph Reed at the business meeting in Los Angeles a year ago. This committee was organized under the chairmanship of Dr. F. H. Lahee and consists of a representative group strategically located throughout the areas in which the Association is actively represented. It is the duty of the members of this committee to solicit papers in their respective districts. The chairman's report on the activities of this committee which will be published in the *Bulletin* will cover in detail the results which it has obtained.

The Society of Economic Paleontologists and Mineralogists, a division of the Association, accepted on July 1, 1937, an invitation to transfer their business affairs to the headquarters of our Association at Tulsa under supervision of Mr. J. P. D. Hull. This necessitated the enlargement of headquarters' space and the addition of one employee; but, due to the financial arrangements already in effect, little additional expense is involved. This consolidation of business affairs under one management relieves the secretary-treasurer of the S.E.P.M. of a considerable burden and tends to make a closer tie between the two organizations. All other functions of the Society remain in the hands of its officers, being in no way affected by the consolidation.

It was the thought of the executive committee that such consolidations tend to knit more closely together the many people whose common problems are the exploration for and exploitation of petroleum deposits.

In addition to meetings following the Los Angeles convention and preceding this convention, the executive committee met as guests of the Shreveport Geological Society in September, and at the mid-year meeting of the Appalachian District at Pittsburgh, and in Wichita, Kansas, in February, as guests of the Kansas Geological Society. On these occasions, Association business was discussed and transacted.

In addition to the foregoing, your president has met with several local societies, including the West Texas Geological Society at Midland, the North Texas Geological Society at Wichita Falls, the Houston Geological Society, and the Dallas Petroleum Geologists. The many courtesies shown and the hospitality extended by members of the Association during these visits are gratefully acknowledged.

In conclusion, I wish to express, on behalf of the executive committee, their appreciation of the whole-hearted cooperation of the headquarters staff. The Association is fortunate indeed in the possession of the sincere, conscientious, and competent group, headed by J. P. D. Hull, who carry on the routine of Association affairs from year to year, under changing conditions and changing executive personnel. They are to be congratulated on a difficult task well done.

H. B. FUQUA, *president*

EXHIBIT II. REPORT OF SECRETARY-TREASURER

(Year Ending March 18, 1938)

MEMBERSHIP

The membership of the Association now stands at an all-time high of 2,646, a net increase of 315 since March 1, 1937. According to records the net increase of 315 members is the largest increase in any one year of the Association's history. Applications for membership continue to come in, and the executive committee is now considering 157 new applications and 20 applications for reinstatement. It is a pleasure to report that the number of members in arrears decreased during the year.

During the past year two outstanding geologists, N. H. Darton and A. C. Lawson, were elected to honorary membership in the Association.

It is the sad duty of the secretary to report the death of 8 members: Leon J. Pepperburg, H. G. Officer, P. V. Roundy, John M. Alden, C. A. Cheney, A. W. Duston, John M. Muir, and Alfred Grossman.

The data on membership are summarized in Tables I, II and III. It is interesting to note that 868 members reside in Texas. Oklahoma, California, and Kansas rank next in the order named and the combined membership of these states is only 10 more than that of Texas. Outside of the United States the membership in Venezuela exceeds the combined membership of Colombia and England which rank second and third.

FINANCES

The audit published in the March, 1938, *Bulletin* and Tables IV, V, VI, and VII give the necessary data on the financial condition of the Association. Both income and expenses increased during 1937. The net operating income of \$843.64 compares favorably with the net operating loss of \$896.05 in 1936. The net income of \$4,481.28 was, however, \$86.48 less than the 1936 net income, due largely to the expense of publishing the *Comprehensive Index*. The printing and binding of this most excellent publication cost \$3,360.98, a figure entirely in line with the value of it. An increase in the cost of publishing the *Bulletin* from 50 cents to 51½ cents per copy is worthy of note. The August *Bulletin* containing Thompson's cross sections was much more expensive than the usual *Bulletin* but the quality of the publication warranted the extra expense. Additional data on Association publications are summarized in Tables VIII and IX.

Due to declining markets the market value of Association investments decreased during 1937. The executive committee, following the advice of the Association's investment counsel, invested only some \$1,500 in additional securities. Three bonds were retired. Income from investments increased \$340.65 to \$2,671.35 in 1937.

At the close of 1937 the investments of the Association were diversified as follows.

Type	Cost	Per Cent	Annual Income
Morris Plan.....	\$ 3,015.22	5.13	\$ 120.60
Bonds.....	31,343.03	53.40	1,247.00
Preferred stocks.....	2,636.86	4.49	113.00
Common stocks.....	21,694.47	36.98	1,073.00
	<u>\$58,689.58</u>	<u>100.00</u>	<u>\$2,553.60</u>

At the present rate the net annual income from investments is \$2,002.53, an income of 3.4 per cent on the total sum invested. Only one bond and one common stock of the investment portfolio do not pay dividends.

BUDGET

Income and expenses for 1938 have been estimated and are listed in Table X. Total income is estimated at \$50,700 and total expenditures at \$50,500.

EXECUTIVE COMMITTEE MEETINGS

The executive committee met during the Los Angeles and New Orleans conventions to transact Association business. Meetings were also held during the mid-year meeting in Pittsburgh, Pennsylvania, October 15; in Shreveport, Louisiana, September 11; in Washington, D.C., December 30; and in Wichita, Kansas, February 23.

HEADQUARTERS OFFICE

During the past year the Society of Economic Paleontologists and Mineralogists, a division of the Association, established a headquarters office adjoining the Association's offices. Their work is being carried on under the direction of business manager Hull. The details of the arrangement have been largely perfected, and it is the hope of both the executive committee of the Association and the Council of the Society of Economic Paleontologists and Mineralogists that the arrangement will work to the advantage of all concerned.

ACKNOWLEDGMENTS

The complete coöperation of the executive committee, the headquarters office, and the various Association committees has made the position of secretary-treasurer an entirely pleasurable one. The secretary-treasurer takes this opportunity to express his sincere appreciation of their support.

IRA H. CRAM, *secretary-treasurer*

TABLE I

TOTAL MEMBERSHIP BY YEARS

May 19, 1917.....	94	March 1, 1928.....	1,952
February 15, 1918.....	176	March 1, 1929.....	2,126
March 15, 1919.....	348	March 1, 1930.....	2,292
March 18, 1920.....	543	March 1, 1931.....	2,562
March 15, 1921.....	621	March 1, 1932.....	2,558
March 8, 1922.....	767	March 1, 1933.....	2,336
March 20, 1923.....	901	March 1, 1934.....	2,043
March 20, 1924.....	1,080	March 1, 1935.....	1,973
March 21, 1925.....	1,253	March 1, 1936.....	2,169
March 20, 1926.....	1,504	March 1, 1937.....	2,331
March 1, 1927.....	1,670	March 1, 1938.....	2,646

TABLE II
COMPARATIVE DATA OF MEMBERSHIP

	<i>March 1, 1937</i>	<i>March 1, 1938</i>
Numbers of honorary members.....	14	16
Number of life members.....	2	2
Number of members.....	1,885	2,064
Number of associates.....	430	564
Total number of members and associates....	2,331	2,646
Increase in membership.....	162	315
Members and associates.....	168	262
Reinstatements.....	88	92
Total new members and reinstatements....	254	354
Applicants elected, dues unpaid.....	19	24
Applicants approved for publication.....	36	70
Recent applications.....	41	63
Total applications on hand.....	96	157
Applicants for reinstatement, elected, dues unpaid.....	14	11
Recent applications for reinstatement.....	8	9
Total applications for reinstatement on hand..	22	20
Applicants approved for transfer, dues unpaid.....	7	1
Applicants for transfer approved for publication...	11	12
Recent applications for transfer on hand.....	5	7
Total applications for transfer on hand.....	23	20
Number of members and associates withdrawn...	7	6
Number of members and associates dropped....	72	25
Number of members died.....	13	8
Total loss in membership.....	92	39
Total gain in membership.....	162	315
Number of members and associates in arrears, previous year.....	51	91
Members in arrears, current year.....	656	645
Associates in arrears, current year.....	158	147
Total number members and associates in ar- rears, current year.....	814	792
Total number members and associates in good standing.....	1,486	1,763

THE ASSOCIATION ROUND TABLE

TABLE III
GEOGRAPHIC DISTRIBUTION OF MEMBERS

March 1, 1938

Alabama.....	4	Kentucky.....	15	Ohio.....	11
Arizona.....	2	Louisiana.....	124	Oklahoma.....	430
Arkansas.....	7	Maine.....	1	Oregon.....	2
California.....	314	Maryland.....	5	Pennsylvania.....	50
Colorado.....	42	Massachusetts.....	7	South Dakota.....	3
Connecticut.....	3	Michigan.....	24	Tennessee.....	7
Delaware.....	1	Minnesota.....	3	Texas.....	868
Dist. of Columbia.....	33	Mississippi.....	3	Utah.....	4
Florida.....	6	Missouri.....	22	Vermont.....	1
Georgia.....	1	Montana.....	8	Virginia.....	4
Illinois.....	49	Nebraska.....	6	Washington.....	5
Indiana.....	7	New Jersey.....	7	West Virginia.....	10
Iowa.....	3	New Mexico.....	20	Wisconsin.....	2
Kansas.....	134	New York.....	77	Wyoming.....	18
		North Carolina.....	2		

Total members in United States..... 2,354

Afghanistan.....	2	Ecuador.....	1	New Guinea.....	4
Africa.....	4	Egypt.....	3	New Zealand.....	1
Arabia.....	2	England.....	22	Peru.....	3
Argentina.....	12	France.....	7	Philippine Is.....	1
Australia.....	9	Germany.....	11	Poland.....	2
Austria.....	1	Guatemala.....	1	Roumania.....	9
Belgian Congo.....	1	Holland.....	21	Scotland.....	2
Belgium.....	1	Hungary.....	1	Sweden.....	1
British West Indies.....	8	Iran.....	1	Switzerland.....	9
Canada.....	19	Iraq.....	4	Syria.....	3
Colombia.....	23	Italy.....	3	Turkey.....	4
Cuba.....	1	Japan.....	3	U.S.S.R.....	2
Dominican Republic.....	1	Mexico.....	20	Uruguay.....	1
Dutch East Indies.....	17	Morocco.....	1	Venezuela.....	50

Total members in foreign countries..... 292

Grand total..... 2,646

TABLE IV
COMPARISON OF ACCRUED INCOME BY CALENDAR YEARS

<i>Dues</i>	1935	1936	1937
Members.....	\$15,860.00	\$18,410.00	\$19,880.00
Associate.....	2,884.00	3,042.00	3,546.00
Total.....	\$18,744.00	\$21,452.00	\$23,426.00
<i>Bulletin</i>			
Subscriptions.....	\$ 3,554.04	\$ 4,072.64	\$ 4,531.94
Advertising.....	4,628.46	5,994.34	7,084.95
Total.....	\$ 8,182.50	\$10,066.98	\$11,616.89
<i>Back Numbers, etc.</i>			
Bound Volumes of Bulletin.....	\$ 2,249.76	\$ 2,449.84	\$ 2,911.60
Back Numbers of Bulletin.....	738.14	1,097.87	1,136.97
Other Publications.....	23.50	55.33	170.70
Total.....	\$ 3,025.90	\$ 3,603.04	\$ 4,219.27

TABLE IV—(continued)

Special Publications

Structure Volume I*	\$ 549.26	\$ 621.53	\$ 135.30
Structure Volume II	629.71	697.36	617.05
Geology of California*	682.15	578.65	196.24
Problems of Petroleum Geology	1,917.21	1,200.88	1,023.80
Geology of Natural Gas*	4,353.40	2,131.65	917.14
Geology of Tampico Region*	—	1,633.60	667.46
Index	—	—	448.36
Gulf Coast*	—	—	4,197.86
Structural Evolution Sou. California*	—	—	1,117.13
Tectonic Map*	—	—	107.87
Total	\$ 8,131.73	\$ 6,863.67	\$ 9,428.21

Other Income

Convention Receipts (Net)	\$ 70.50	\$ 112.51	—
Delinquent Dues Charged Off	2,820.00	567.00	\$ 544.00
Interest	1,504.71	1,749.67	2,074.47
•	61.79	63.65	65.63
•	719.65	519.36	501.78
Miscellaneous	138.96	32.05	29.47
•	7.50	—	—
Sale of Library	—	535.25	56.50
Members Reinstated	—	167.85	210.10
Bad Debt, Back Interest, Recovered	—	257.33	160.00
Cancellation Investment Reserve	—	1,895.41	—
Inventory Increase	—	—	1,313.87
Total	\$43,407.24	\$47,885.77	\$53,646.19

* Income of Publication Fund.

† Income of Research Fund.

TABLE V
COMPARISON OF ACCRUED EXPENSES BY YEARS

<i>General and Administrative Expenses</i>	1935	1936	1937
Salaries—Manager	\$ 2,081.32	\$ 1,783.04	\$ 2,782.50
Clerical	5,541.48	5,459.08	5,675.69
Rent	600.00	1,120.00	1,460.00
Telephone and Telegraph	361.84	342.35	444.58
Postage	1,389.90	1,117.32	1,315.62
Office Supplies and Expenses	476.16	813.31	501.51
Printing and Stationery	388.43	321.47	440.16
Executive Expense	151.69	—	—
Audit Expense	300.00	300.00	300.00
Insurance and Taxes	155.28	163.58	155.14
Convention Expense	—	—	388.25
Freight and Express (Shipments from Tulsa)	104.99	178.76	254.17
Exchange and Refunds	—	13.97	—
Bad Debts	43.40	—	—
Donations—Soc. Econ. Paleon. and Min.	530.00	500.00	500.00
Soc. Explor. Geophysicists	250.00	—	—
Soc. Economic Geologists	250.00	250.00	250.00
Research Committee Expense	57.60	—	—
Miscellaneous	26.73	14.51	253.76
Depreciation—Furniture and Fixtures	384.86	374.07	393.39
Investment Counsel	—	200.00	400.00
Loss on Bonds, etc. (Net)	—	28.98	4.31
Total	\$13,093.68	\$12,980.44	\$15,519.08

THE ASSOCIATION ROUND TABLE

TABLE V—(continued)

<i>Publication Expenses</i>			
Salaries—Manager	\$ 2,500.00	\$ 2,700.00	\$ 2,925.00
Editorial	3,414.40	1,550.60	3,405.22
Printing Bulletin	\$10,468.02	\$11,554.05	\$12,144.88
Engravings	1,905.41	1,094.44	1,695.20
Separates	394.66	261.98	246.59
Stencils and Mailing	146.30	167.47	184.36
Binding Bulletins	362.69	341.75	409.04
Postage and Express (Bulletins)	762.56	801.89	887.76
Copyright Fees	24.00	24.00	24.00
Freight, Express, Postage (Other Publications) Shipments from printers	311.30	677.64	1,343.55
Discounts	63.85	78.00	51.97
Purchase of Back Numbers	250.40	49.00	—
Bad Debts	40.50	97.40	269.31
Miscellaneous	32.31	244.81	169.48
Special Publications	9,774.99	6,830.69	9,799.47
Refunds—Unavailable Bulletins	—	347.00	—
Obsolescence of Printed Matter	—	319.05	—
Bulletin Inventory Decrease	—	2,597.80	—
Total	\$30,511.39	\$30,337.57	\$33,645.83
Total Expense	\$43,605.07	\$43,318.01	\$49,164.91

TABLE VI
COMPARISON OF NET INCOME BY YEARS

	1935	1936	1937
Accrued Income	\$43,407.24	\$47,885.77	\$53,646.19
Expenses			
General and Administrative	13,093.68	12,980.44	15,788.39
Publication	30,511.39	30,337.57	33,376.52
Total	\$43,605.07	\$43,318.01	\$49,164.91
Excess Income over Expenses	\$ 197.83	\$ 4,567.76	\$ 4,481.28

TABLE VII
INVESTMENTS

	Cost	Market Value End of Year
<i>1935 Values</i>		
General Fund	\$26,531.33	\$25,423.50
Publication Fund	14,435.02	12,568.47
Research Fund	1,416.72	1,396.72
Total	\$42,383.07	\$39,388.69
<i>1936 Values</i>		
General Fund	\$41,707.03	\$43,255.77
Publication Fund	12,635.94	14,097.03
Research Fund	1,480.16	1,568.15
Total	\$55,823.13	\$58,920.95
<i>1937 Values</i>		
General Fund	\$44,431.55	\$38,288.12
Publication Fund	12,712.40	11,397.84
Research Fund	1,545.57	1,449.93
Total	\$58,689.58	\$51,135.89

TABLE VIII
COMPARISON OF COST OF BULLETIN

	1935	1936	1937
Total Expenses.....	\$19,707.66	\$18,994.30	\$21,663.21
Monthly Edition.....	3,000	3,200	3,500
Total Copies Printed.....	35,951	38,400	42,000
Total Pages Printed, Including Covers....	2,236	2,094	2,061
Total Pages of Text.....	1,868	1,722	1,641
Total Cost Per Copy.....	0.55	0.50	0.515

TABLE IX

(Part 1)

SPECIAL PUBLICATIONS

	Structure Vol. I	Structure Vol. II	Geology Calif- ornia	Problems Petrol. Geology	Geology Natural Gas	Geology Tampico Region	Total
Inventory							
Dec. 31, 1936.....	\$ 69.84	\$1,357.20	\$ 81.88	\$ 958.75	\$4,352.00	\$2,404.50	\$9,224.17
Dec. 31, 1937.....	—	950.40	—	374.05	3,528.00	1,990.01	6,843.06
Sales.....	135.30	617.05	106.24	1,023.80	917.14	607.46	3,556.99
Total Edition.....	2,500	2,500	1,500	2,034	2,500	1,575	
Copies on Hand							
Dec. 31, 1936.....	24	377	46	325	1,088	1,050	
Dec. 31, 1937.....	—	204	—	127	882	869	
Number of Pages.....	510	780	355	1,073	1,227	280	
Cost (inventory) per Copy.....	\$2.91	\$3.60	\$1.78	\$2.05	\$4.00	\$2.20	
Selling Price, When Issued, per Copy.....	4.00	4.00	4.00	5.00	4.50	3.50	
Present Selling Price							
Members and Associates.....	—	5.00	—	5.00	4.50	3.50	
Non-Members.....	—	7.00	—	6.00	6.00	4.50	

TABLE IX

(Part 2)

SPECIAL PUBLICATIONS

	Compre- hensive Index	Gulf Coast Oil Fields	Struc. Evol. Southern California	Tectonic Map, Sou. California	Total	
Inventory	Cloth	Paper				
Dec. 31, 1937.....	\$265.95	\$2,033.50	\$2,062.12	\$304.58	\$56.64	\$4,812.79
Sales.....	448.36	—	4,197.86	1,117.13	107.26	5,870.61
Total Edition.....	2,837	1,271	2,510	1,047	940	
Copies on Hand						
Dec. 31, 1937.....	154	1,225	1,175	362	708	
Number of Pages.....	382	382	1,070	157		
Cost (inventory) per Copy.....	\$1.727	\$1.66	\$1.755	\$1.09	\$0.08	
Selling Price When Issued per Copy						
Members and Associates.....	\$2.00	—	\$3.00	\$2.00	\$0.50	
Non-Members.....	3.00	—	4.00	2.00	0.50	
Present Selling Price						
Members and Associates.....	2.00	—	3.00	2.00	0.50	
Non-Members.....	3.00	—	4.00	2.00	0.50	

TABLE X

	BUDGET, 1938	Estimated 1938
<i>Revenues</i>		
<i>Dues</i>	\$23,426.00	\$24,000.00
<i>Bulletin</i>		
Subscriptions.....	4,531.94	4,600.00
Advertising.....	7,084.95	7,000.00
Bound Volumes.....	2,911.60	2,900.00
Back Numbers.....	1,136.97	1,000.00
<i>Special Publications</i>		
Structure Volume I.....	135.30	—
Structure Volume II.....	617.05	500.00
Geology of California.....	196.24	—
Problems of Petroleum Geology.....	1,023.80	200.00
Geology of Natural Gas.....	917.14	800.00
Geology of Tampico Region.....	667.46	600.00
Comprehensive Index.....	448.36	300.00
Gulf Coast Oil Fields.....	4,197.86	3,500.00
Struc. Evol. Southern California.....	1,117.13	600.00
Tectonic Map Southern California.....	107.87	50.00
Other Publications.....	170.70	150.00
Miocene Stratigraphy California.....	—	1,500.00
<i>Other Income</i>		
Delinquent Dues Charged Off.....	544.00	200.00
Bad Debt, Back Interest, Recovered.....	160.00	100.00
Interest.....	2,641.88	2,500.00
Sale of Library.....	56.50	50.00
Members Reinstated.....	210.10	150.00
Total.....	\$52,302.85	\$50,700.00
<i>Expenses</i>		
General Administrative (Audit Schedule 3).....	\$15,395.83	\$18,000.00
Publication (exclusive of following books).....	24,689.90	25,000.00
Miocene Stratigraphy of California.....	—	3,500.00
Comprehensive Index.....	3,360.98	—
Struc. Evol. Southern California.....	1,220.65	—
Gulf Coast Oil Fields.....	4,104.99	500.00
Special Publications.....	—	3,500.00
Total.....	\$48,772.35	\$50,500.00

EXHIBIT III. REPORT OF EDITOR

The members of the A.A.P.G. who are interested in statistical data and comparisons will find that the *Bulletin* during 1937 followed pretty closely the standards set up in previous years. It was felt by the editorial staff that no changes in policy were necessary. The excellent groundwork built up by painstaking effort on the part of previous editors has provided not only a foundation but also a working model that is difficult to improve upon. The guiding principle throughout the year has been to furnish the greatest amount of entertaining and instructive reading to the greatest number of our members. Whether this ideal has been attained or not can only be decided by an expression of opinion from the members themselves. Therefore each and every member is urged to write the editor his comments soon and often. Some members undoubtedly favor papers of a general nature covering structure, stratigraphy, and producing horizons as well as data on production problems and related engineering features. Others may favor papers which emphasize tech-

nical details and present an exhaustive analysis of a special problem or situation. Please tell us what you would like to read in the *Bulletin*.

Table I shows that a very desirable geographical diversification was attained. Texas, which has the largest area and the largest number of oil-producing districts, leads with sixteen papers. It is followed by Oklahoma, Kansas, California, Louisiana, and the Rocky Mountain states, each of which have more than three papers. Very few of the producing states or areas have been neglected. Among foreign countries, South America is represented by four papers, Europe by one, and Africa by one.

On the basis of subject matter a similarly broad diversification may be noted (Table II). Articles dealing with porosity and permeability number five, those on stratigraphy also five. Three articles were printed on each of the following topics: reserves, structure, and chemistry of oil. Other topics covered by one or more articles include such widely differing fields of interest as insoluble residues, source beds, orogeny, sand analysis, migration, and X-ray analysis.

To a large extent the credit for this gratifying result must be given to the untiring efforts of the committee for publication. Under the chairmanship of F. H. Lahee twenty-two members were selected from the various districts in the early months of 1937 to solicit interesting contributions from members. Like every new project, the work of this committee got under way slowly, but the cumulative effect of their effort began to appear toward the end of the year. Lest our members get the impression that they can now sit back and get ready to be entertained, the editor wishes to state with all the emphasis possible, that good papers are still extremely few. The need for our members at large to send in contributions is still very urgent. The articles need not be scholarly dissertations, nor must they be lengthy.

The Association may justly take pride in the list of special publications which it has sponsored in the past. No additional number of this series was issued during the year. It is possible to report, however, that the special publication, *Miocene Stratigraphy of California*, which was authorized by the executive committee last year, is now nearing completion and will probably be available to members during 1938.

In order to allow members to compare the *Bulletin* of 1937 with that of previous years, the following statistical data are presented.

TABLE I
GEOGRAPHICAL DISTRIBUTION OF ARTICLES

Texas.....	16	Rocky Mountains.....	4	Mississippi.....	1
Oklahoma.....	8	Arkansas.....	3	Pennsylvania.....	1
Kansas.....	7	New Mexico.....	2	Illinois.....	1
California.....	7	New York.....	2	Virginia.....	1
Louisiana.....	4	Michigan.....	1	Missouri.....	1

TABLE II
DISTRIBUTION OF ARTICLES BY SUBJECT MATTER

Porosity and permeability.....	5	Structural problems.....	3	Orogeny.....	1
Stratigraphy.....	5	Sedimentology.....	2	X-ray analysis.....	1
Chemistry of oil.....	3	Insoluble residues.....	2	Micro-paleontology.....	1
Reserves and economics.....	4	Sand analysis.....	1	Acidization.....	1
		Migration.....	1	Water analysis.....	1
				Core analysis.....	1

TABLE III
1937 BULLETIN

Month	Pp. Majors	Pp. Minors	Pp. Maj. and Min.	Roman	Total Pp.
January.....	110	38	148	28	176
February.....	119	25	144	32	176
March.....	59	69	128	32	160
April.....	104	24	128	28	156
May.....	78	70	148	28	176
June.....	109	27	136	32	168
July.....	114	30	144	32	176
August.....	115	9	124	36	160
September.....	105	35	140	28	168
October.....	99	37	136	32	168
November.....	117	19	136	28	164
December.....	62	67	129	36	165
Total.....	1,191	450	1,641	372	2,013
Monthly Average.....	99.2	37.5	136.7	31	167.7

TABLE IV
PAGES IN BULLETIN

	1936	1937
Total number of pages of majors.....	1,300	1,191
Total number of pages of minors.....	422	450
Total number of pages of majors and minors.....	1,722	1,641
Total number of Roman pages.....	308	372
Total number of pages.....	2,030	2,013
Total number of illustrations.....	372	388
Total number of major articles.....	61	70
Total number of minor articles*.....	74	83

* Minor articles: geological notes, discussions, reviews, memorials.

W. A. VER WIEBE, *editor*

EXHIBIT IV. REPORT (MINUTES) OF BUSINESS COMMITTEE

Roosevelt Hotel, New Orleans, Louisiana, March 15, 1938

The meeting was called to order at 2:25 P.M. by Harold W. Hoots, chairman.

The following members were present.

Executive committee: H. B. Fuqua, C. L. Moody, Ira H. Cram, W. A. Ver Wiebe, Ralph D. Reed*Members-at-large:* David Donoghue, E. DeGolyer, Alexander Deussen, John C. Karcher, Ed. W. Owen, Fritz L. Aurin, vice-chairman*Division of Paleontology:* Stanley G. Wissler, Henry V. Howe*District Representatives*

Amarillo, not represented

Appalachian, not represented

Canada, S. E. Slipper represented by T. A. Link

Capital, Arthur A. Baker

Dallas, not represented

East Oklahoma, C. G. Carlson, Frederic A. Bush represented by A. I. Levorsen

Fort Worth, J. F. Hosterman

Great Lakes, Benjamin F. Hake

Houston, J. Brian Eby, Orval L. Brace, David Perry Olcott

Mexico, William A. Baker, Jr.

New Mexico, not represented

New York, W. T. Thom, Jr.

Pacific Coast, Harold W. Hoots represented by F. A. Morgan, A. A.

Curtice, Homer J. Steiny represented by C. R. McCollom

Rocky Mountain, J. Harlan Johnson

Shreveport, A. F. Crider

South America, not represented

South Permian Basin, not represented

South Texas, Fred P. Shayer, R. F. Schoolfield

Tyler, A. C. Wright represented by C. Lathrop Herold

West Oklahoma, not represented

Wichita, Edward A. Koester

Wichita Falls, not represented

1. *Minutes of previous meeting.*—It was moved, seconded, and carried that the reading of the minutes of the last meeting of the committee be omitted, as the minutes had been published in the *Bulletin*.

The reports of the following committees were read.

2. *Report of the committee on geologic names and correlations*, John G. Bartram, chairman.

3. *Report of representative of Association on Division of Geology and Geography, National Research Council*, F. H. Lahee, representative.

4. *Report of the committee for publication*, F. H. Lahee, chairman.

5. *Report of committee on applications of geology*, Frank R. Clark, chairman.

6. *Report of the research committee*, Donald C. Barton, chairman.

After the reading of the reports it was moved, seconded, and carried that the reports be accepted and referred to the annual business meeting with the recommendation that they be not read but that they be published in the May, 1938, *Bulletin*.

7. It was moved, seconded, and carried that the following resolution be referred to the executive committee for study during this year, and brought up next year if they find it advisable.

Whereas, the Constitution of the American Association of Petroleum Geologists states: "The object of this Association is . . . to promote the technology of petroleum and natural gas and to encourage improvements in the methods of . . . exploiting these substances . . ." And

Whereas, many members of the American Association of Petroleum Geologists are engaged in the exploitation branches of the petroleum and natural gas industries, there has been a dearth of manuscripts on exploitation problems submitted for publication in the *Bulletin* and also a lack of effort to maintain the Association's objective in this particular field. Therefore,

Be it resolved, that the Association solicit manuscripts on exploitation problems for publication in the *Bulletin*; and

Be it further resolved, that the Association invite applications for membership from among those engaged in the exploitation field and who have the qualifications required for membership.

8. *S.E.P.M. resolution*.—It was moved, seconded, and carried that action be deferred on the following resolution and that it be considered at the joint meeting of the executive committee and representatives of the S.E.P.M. on Friday.

Resolved, that we, the Society of Economic Paleontologists and Mineralogists, express our approval of the project known as Geological Research Division of Foraminifera sponsored by the American Museum of Natural History under the direction of Brooks F. Ellis, having for its purpose the compilation of the pertinent data of all species of foraminifera; that the Society particularly urge that this material be made available in printed form as the most important step of the project; that copies of this resolution be forwarded to the American Museum of Natural History and to Doctor Ellis.

9. *Recommendation for appointment of committee*.—Motion made by Ed. W. Owen that the executive committee appoint a committee of four men to make a thorough study of present committees and analyze their duties and make definite recommendations for committees to be retained in time to be taken up at next year's meeting.

Amendment proposed by F. A. Morgan: Resolved, that it be the sentiment of this meeting that the incoming president, with the assistance of the incoming executive committee, make a complete study and review of all Association committees, their functions and personnel, and that a complete report of findings with recommendations be presented at the business meeting next year.

Amendment seconded and adopted. Original motion withdrawn by Mr. Owen.

The following resolutions were moved, seconded, and adopted.

10. *West Texas Geological Society*.—That the application of the West Texas Geological Society to become affiliated with the Association be approved and recommended to the annual business meeting.

11. *Western Kentucky Geological Society*.—That the application of the Western Kentucky Geological Society to become affiliated with the Association be approved and recommended to the annual business meeting.

12. *North Texas Geological Society*.—That the application of the North Texas Geological Society to become affiliated with the Association be approved and recommended to the annual business meeting.

13. C. E. Dobbin, as representative for the Rocky Mountain Association of Petroleum Geologists, extended an invitation to the American Association of Petroleum Geologists to hold a meeting at Estes Park, Colorado, next September.

It was moved, seconded, and carried that it be recommended to the executive committee for consideration.

The meeting of the general business committee adjourned at 4:10 P.M.

HAROLD W. HOOTS, *chairman*

IRA H. CRAM, *secretary*

EXHIBIT V. REPORT OF COMMITTEE ON GEOLOGIC NAMES AND CORRELATIONS

This is the report of the committee on geologic names and correlations which held its meeting Thursday morning, March 17.

The committee on geologic names and correlations was created several years ago to cooperate with similar committees from three other geological

organizations in the preparation of a set of rules for the classification and nomenclature of rock units. Such a set of rules was published in the *Association Bulletin* and elsewhere and the continued function of the committee has been to see that the members followed those rules in their geologic work. This can best be accomplished by individual effort in the various sections. There has been a member of this committee in each important district of the Association and it is the duty of each to coöperate with the associate editor, to advise the members when problems of nomenclature and classification arise and to initiate corrective measures in a section if they appear advisable. When the adopted rules of classification are correctly followed and no problems arise, the member may have little to do.

During the past year there have been few problems. In Shreveport they are discussing the classification of the rocks generally called the Trinity group and the local society coöperating with the member of this committee has appointed a sub-committee to study the problem. Their report will be submitted to the committee on geologic names and correlations for action some time this year. It is possible that the rules written for subsurface nomenclature and classification are inadequate and it may prove necessary to consider new and more complete rules. That is probably a future task for this committee.

In the Rocky Mountains, the committee member has initiated the simplification of names in the Upper Cretaceous and the discarding of useless names and some progress has been made. Other individual members will consider similar situations.

The members of this committee feel that it serves a useful purpose in the Association and respectfully requests that it be made a permanent committee, and that its organization and duties be included in the Constitution and By-laws of the Association. They recommend that the committee consist of at least one member from each section or area where a considerable number of Association members are doing geologic work and may publish; that members serve for 3-year periods; and that members appointed for next year be for 1, 2, and 3 years, respectively, to start the system of rotation. It is understood, and should be so stated, that this committee is advisory and does not make final decisions. In cases of disagreement with authors over the use of names and correlations, this committee will report in writing to the executive committee and to the editor for their final decision.

Nine members of this committee, the editor, and the business manager attended the breakfast meeting held Thursday at 8:00 A.M. This compares with attendances of 3 or 4 on previous meetings held on Tuesday morning. Since this committee will almost never report matters that call for action by the committee of business representatives on Tuesday afternoon, it is recommended that the future meetings be handled as this year.

JOHN G. BARTRAM, *chairman*

EXHIBIT VI. REPORT OF RESEARCH COMMITTEE

The work of the research committee during the past year again has been rather routine. The committee never has had difficulty in envisaging projects which would be very worth while to carry out, but an insuperable drawback, in general, has been the lack of some one having time, inclination, and qualifications to carry out the project. The members of the committee are busy men, whose time is fully occupied with their own individual tasks and interests.

The service of the members inevitably must be rather routine, and their function must be to attempt to instigate and to encourage research and to give advice, aid, and support to the individual man who does have the time, inclination, and qualifications to carry those projects through.

The annual dinner and open discussion meeting of the committee were held on Tuesday evening preceding the opening of the general meeting of the Association at Los Angeles last March. The key topic of the discussion was "The Origin of Oil." Parker D. Trask opened the discussion. The attendance at the open discussion meeting was the largest that the committee has had at any of these meetings; well over 200 were present. The discussion lasted until 11:30 P.M.

No mid-year meeting of the committee was held this year. With the growing importance and elaborateness of the annual meetings of the San Antonio, Shreveport, and Kansas local geological societies, and of the mid-year meetings of the Society of Exploration Geophysicists and of the Production Section, A.I.M.E., and with the many other calls on their time, the members of the committee find difficulty in taking time to attend yet another meeting.

Professors Van Tuyl and Parker write that they have made good progress with their project on the "Time of the Accumulation of Oil and Gas." In acting as the keynote speakers at the open discussion meeting of the committee this year, they are to give a report of progress. During the year they applied for a grant of \$200.00. In a poll by mail, the majority of the committee approved a recommendation to the executive committee that the grant be made, and the grant was made by the executive committee.

In connection with the instructions from the committee to confer with the president of the Society of Economic Paleontologists and Mineralogists in regard to the proper description in publication of the undescribed species and genera much used by oil geologists, and in regard to the Brooks Ellis project, I had correspondence with Mr. Wissler, president of the S.E.P.M. and he appointed an S.E.P.M. research committee with Norman L. Thomas chairman. Mr. Thomas writes that his committee has engaged in considerable correspondence concerning research and research projects but has found correspondence unsatisfactory and has postponed making definite recommendations until after the committee meets at New Orleans. I doubt whether the report from that committee will be available for discussion at the business meeting of this committee. Informally, I understand that Mr. Thomas' committee are divided in their opinions in regard to the Brooks Ellis project.

The appointment of a research committee by the Society of Economic Paleontologists and Mineralogists is one of the most noteworthy events within the domain of research by the oil industry. Norman L. Thomas, the chairman, writes that the committee has been discussing the following.

1. Brooks Ellis' proposed micro-paleontological department of the American Museum of Natural History
2. Faunal zonation charts
3. Publication of new species available from oil-company laboratories
4. Aid to authors in the matter of illustration
5. Encouragement of companies to permit release of non-confidential paleontologic information not to the disadvantage of the worker but to his advantage and not to injury to the company but to the benefit of the company. In general the more generous the company in exchanging information the more progressive and successful is that company. This may not be true in particular instances but it has been true in the long run

6. Encouragement of economic paleontologists to present information and ideas and coöperation with them in their projects
7. Publication of all foraminifera which are valuable to the commercial worker in one volume or set of volumes under the supervision of some authority on the subject
8. A comprehensive paleontology sponsored by companies but largely written by the authorities
9. Compilation of stratigraphic sections showing fossil zones
10. Index card system for fossils
11. Description of important collecting grounds

He says: "We desire the ideas and coöperation of your committee and we assure you that we stand ready to help you in every way possible." That committee seems to me to have great potentialities for usefulness both scientifically and commercially. For a number of years I have been impressed with the great quantity of manuscript paleontological data which have been piling up in the company laboratories. Most of the data are not confidential and their publication would not be subject to the objections which company legal departments raise against the release of data in regard to oilfields. Coöperative organization of the data in the long run should prove advantageous to the large companies. Coöperative activity in the organization of that data lies much closer to the line of company work and it should be easier to sell the idea of this type of coöperative activity to executives than most types of coöperation. The committee, therefore, has an important function before it in organizing such coöperative activity.

The relations between that committee and this committee should be close. The research committee of the Association should stand as close to the research committee of the Society of Economic Paleontologists and Mineralogists as the Association stands to the Society. If the research committee is to remain as an active committee of the Society, I would like to suggest that the chairman of the committee be made ex-officio a member of the research committee of the Association, and possibly a vice-chairman of the committee, as the two committees should coöperate closely.

In connection with the delegate of the Association to the National Research Council, I would like to suggest that the chairman of the research committee of the Association be regarded as the logical nominee, or if he is not eligible under the by-laws of the National Research Council, that the chairman of the research committee of the S.E.P.M. be considered as a nominee. The delegate should be someone who will be able to attend the annual meeting of the Division of Geology and Geography of the National Research Council at the first of May each year. The delegate has a 3-year term and is not eligible to succeed himself. Dr. Lahee, the present delegate, has 2 years to serve; and the question of the appointment of a delegate does not come up this year.

The activities of the individual members of the committee have continued this year much as in the past. But a tendency for them to become more involved in executive work seems evident.

Parker D. Trask continued his studies under American Petroleum Institute project No. 4 entitled "Origin and Environment of Source Rocks." While this work is in no way controlled by our Association, it is of much importance for us to learn of his results.

We feel he should continue his work. We think, however, that at least for the present, his work and results are primarily applicable to environments

of oil fields rather than that they are directly applicable to source rocks. As we see it, the results that may be hoped for most reasonably are criteria to discriminate between the environments of oil fields and regions where oil will not be found, even on favorable structure.

In regard to the state of geologic research in the oil industry, I have nothing to add to my extensive report of last year. The variation in the character and intensity of the research from one year to the next is slight, although over a period of 5 years, it is considerable. Within the fields which come under my attention, the only change from last year has been a slight increase in the attention paid to research on electrical methods in exploration for structure, and on soil analysis and soil gas analysis as methods of exploration for oil deposits.

DONALD C. BARTON, *chairman*

EXHIBIT VI-A. SUPPLEMENTARY REPORT

The research committee has no recommendations to present to the business committee requiring specific action.

The following resolution was passed by the committee.

Resolved: That the committee approves the continuance of the project by Professors Van Tuyl and Parker on the "Time of Accumulation of Petroleum Deposits" and expresses the opinion that devotion of time and space to the consideration of old theories is undesirable and the efforts of Professors Van Tuyl and Parker should be confined rather to the assemblage, presentation, and organization of data, chiefly new data.

John L. Rich reported that stress of other work precluded attention to the project of taking stock of the fundamental problems of oil geology.

In regard to last years' request from the committee to get in touch with *Science Service* in connection with publicity in regard to research, Parker D. Trask reported that *Science Service* would be glad to make use of digests giving the highlights of articles of general interest, if the committee would make arrangement to provide them. *Science Service* will be glad to rewrite the digests in popular form. That is one of the many well worth while projects, which require expenditure of time and energy, and therefore are impracticable, unless someone has enough special interest in the project to carry it through.

An informal report on the Brooks Ellis project was made by Maynard P. White of the research committee of the Society of Economic Paleontologists and Mineralogists. But in the absence of any report from the chairman of that committee, the committee took no action on that project.

Discussion was held in regard to the desirability of reorganization of the committee with the purpose of getting in younger men who will have more time for activities in behalf of the research committee. Most of the present committee have served more than one term and have a great many more calls on their time and energy than when they were first appointed and can give little time to activities of the committee. According to the consensus, a committee composed in considerable part of able but less well known men might be able to accomplish more in behalf of research than the present committee; the younger men are likely to have more time and have the incentive of having to make their mark. The terms of 14 out of 24 members of the committee expire at this meeting. The committee recommends informally to the incoming president and executive committee careful consideration of the

appointment of able and ambitious but not necessarily well known youngsters in place of the older well known men whose terms are expiring.

DONALD C. BARTON, *chairman*

NEW ORLEANS, LOUISIANA
March 15, 1938

EXHIBIT VI-B. SECOND ANNUAL REPORT ON STUDY OF TIME OF ORIGIN AND
ACCUMULATION OF PETROLEUM SUBMITTED TO RESEARCH
COMMITTEE OF A.A.P.G. BY F. M. VAN TUYL AND
BEN H. PARKER

Soon after the authors became interested in research along this line they realized the inadequacy of the present literature on the subject and decided to appeal directly to a large number of petroleum geologists for field evidence bearing upon the problem. An early request for coöperation was in the form of a short article published in the February, 1937, *Bulletin* of the A.A.P.G. Almost simultaneously, about 260 form letters were sent out to leading geologists, urging them to forward any relevant information which they might possess.

It soon became apparent that many were greatly interested in the proposed research, but that few were able to offer concrete evidence for the reason that criteria for the solution of the problem had not been presented. However, some important observations were compiled as a result of this procedure.

A short time before the March, 1937, meeting of the A.A.P.G., Dr. D. C. Barton, chairman of the research committee, expressed a desire that we present to the committee an outline of the problem and the suggested method of attack in order that it might consider the feasibility of sponsoring the project.

At the Los Angeles meeting, the facts were laid before the committee which showed sufficient interest in the subject to sponsor the study. Since that time, Dr. Barton has been untiring in his efforts to promote the investigation. Several other members of the research committee have also rendered valuable service.

After considerable thought, the conclusion was reached that more satisfactory results might be obtained if specific questions were asked regarding field relations bearing upon the time of origin and accumulation of oil and gas. Accordingly, a questionnaire was prepared covering situations that we considered had not been adequately discussed in the literature.

In preparing this questionnaire the authors have attempted to use an unbiased viewpoint as regards both time and manner of origin and accumulation. To assure this we have tried to consider all beliefs receiving serious attention by the oil fraternity and in doing so have included some questions which perhaps would be considered of small importance by most petroleum geologists.

About twelve hundred copies of the questionnaire have been forwarded to petroleum geologists the world over. At the same time, form letters appealing for coöperation, and a statement from Dr. Barton regarding the sponsorship of the research committee were mailed to each of those to whom questionnaires had been sent. Several weeks after these were addressed, a follow-up letter was sent to the chief geologists and district geologists of the important American oil companies. Most of the questionnaires were sent to geologists

in the more responsible positions and to those interested in research as indicated by their writings in recent years. No doubt a number of investigators who have assembled information on the subject have been overlooked. It is hoped that these may be contacted before the present study is completed.

Up to the present time, eighty-two questionnaires have been returned with contributions by geologists in the United States and thirteen from geologists in foreign countries. Many others have indicated their intention to forward data at a later date. Information has been received from every important oil district in the United States and practically every foreign country having substantial oil production except Russia. The reasons for this situation are not known to us. If the research committee can be of any service to us in stimulating interest in this problem among the Russian geologists, we shall appreciate their efforts very much indeed. There is such a wide range of occurrences of oil in that country, that it is apparent that valuable data bearing on this problem must be available.

A report including some of the more outstanding replies to the questionnaire will be presented at the research committee round-table discussion.

In assembling the data it has become apparent that some of the queries in the original questionnaire were not well stated and that they had caused some confusion in the minds of the geologists to whom they had been submitted. These ambiguities have now been eliminated so far as possible in a revised questionnaire. Copies of this new questionnaire will be distributed prior to the discussion dinner meeting tonight. Appended to this report are copies of the original questionnaire, the accompanying correspondence, and the revised questionnaire.

This study has involved a large amount of correspondence, the entire expense of which has been borne by the Colorado School of Mines.

The grant of \$200.00 which was voted by the research committee to defray the expense of translating foreign articles has not yet been drawn upon. However, a considerable amount of translating will have to be done before the work is completed, unless we can gain the cooperation of leading geologists in several foreign nations who will send us a digest in English of the important information available in the literature of their countries. It is our desire that this fund continue to be held available for translating expense.

Prior to the completion of the investigation, some field work should be undertaken in critical areas where observations can be made to advantage on the relation of bituminous sands to associated rocks, and on related problems. We should like to know if the research committee would be willing to assist us in securing a grant of \$500.00 from the Geological Society of America or from one or more interested oil companies to finance the actual field cost of such studies.

It is apparent that an adequate final report on the results of this investigation should include a critical review of all of the theories of origin, migration, and accumulation of petroleum. This should involve a printed report of not less than 200 pages. It is believed that the report will be ready for printing not later than September 1, 1939. It will be optional, of course, with the research committee as to whether it desires to use this report and if so, how it should be issued.

GOLDEN, COLORADO
March 11, 1938

EXHIBIT VII. REPORT OF COMMITTEE ON APPLICATIONS OF GEOLOGY

This committee was organized in 1932, and was first designated the committee on public relations, but this name was changed at the annual meeting in 1933 to the committee on applications of geology, which name is more suggestive of the aims of the association in publicizing geology.

The first report of this committee was published in the May, 1933, *Bulletin* by its first chairman, F. H. Lahee. Subsequent reports have been published in the May *Bulletin* for each succeeding year. A review of these reports indicates the scope of the committee's activities and the work accomplished in the few year's efforts. Thanks is extended to all committee members, and all other geologists, for their coöperation and efforts in bringing geology and its practical application to the attention of the general public.

This report outlines briefly the activities of the members of the committee during the past year, which shows continued progress; but in some districts interest is lagging. We have, in general, followed the original aims and objects, namely, to inform people of the scope and practical application of geology, and to make the layman geology-conscious, but the field of possibilities is so large that we have barely scratched the surface. The committee needs to be composed of members who are interested and energetic, and whose official duties bring them in contact with the general public.

The following is a brief digest of reports received from various members of the committee.

Hal P. Bybee, of the University of Texas at Austin, reports his efforts to popularize geology in his work as counselor for the Merit Badge in Mining for the Boy Scouts of America. He says that this badge is the most difficult merit badge to obtain out of the 104 merit badges awarded to outstanding scouts. Recipients of this badge must answer 15 questions, scout manual, pages 431 to 432, pertaining to geology, which necessitates a rather thorough knowledge of elementary geology. Bybee suggests that members of the association could accomplish much in publicizing geology by interesting themselves in this scout activity.

Carey Croneis, of the University of Chicago, reports nothing spectacular in publicizing geology in the Chicago district, but states that a number of local geologists have continued to give popular and semi-popular lectures, which are of general interest to the public.

He also reports that M. M. Leighton of the Illinois Geological Survey has been engaged in popularizing geology as chairman of the G.S.A. committee, working along similar lines.

Croneis also calls attention to the Merit Badge of the Boy Scouts of America, and suggests that members of the Association could accomplish much by affiliating themselves with this Boy Scout movement.

E. K. Soper, of the University of California, states that the courses in elementary geology, which he and his associates introduced into the large high schools of Los Angeles some years ago, are now well established and need no further attention from this committee. During the past year he prepared a brief talk on the geology of landslides, which was broadcast over the University of California radio programs on a Pacific Coast hook-up. Also, he prepared a popular article on geology with special reference to landslides and earthquakes, which was recently published as a feature article in the Sunday magazine section of the *Los Angeles Times*.

A. E. Brainerd, of Denver, Colorado, reports that the general public are always invited to their meetings, and in this way many people have become interested in geological work. He also states that elementary courses in geology are offered in the high schools of Denver, and efforts are now being made through teachers in the school to interest more of the younger students in these courses.

I. O. Brown, of San Antonio, reports that continued efforts are being made to publicize geology. The local museum is still maintained and important additions are being made to this collection.

Olin G. Bell, of Houston, Texas, reports that the local society has held numerous open meetings at Houston Public Library, at which talks of interest to the public were given. Several speakers talked at the Y.M.C.A. night school and particularly its School of Law in a course on oil and gas law. These talks dealt with the connection between the geologic and legal aspects of the petroleum industry. Also, several talks were given by association members at the Houston University night school.

H. S. McQueen, of the Missouri Geological Survey, reports continued satisfactory progress in publicizing geology in Missouri. From the many requests annually received by the Survey for advice regarding water supplies from wells drilled, it is apparent that the public is becoming more conscious of the relation of geology to water resources. For many years the Survey confined its efforts, in the main, to working out the geologic details and finally furnished a report for water supplies to be utilized by municipalities. During the last year, particularly, inquiries came from individuals requesting information as to the probable depth of a well and the amount of casing that should be used in order to protect it adequately from contamination. In this connection, the Survey furnishes the owner of the well and the driller with a colored strip log showing the character of the rocks and formations penetrated, based on examination of the samples.

In the field of municipal ground water supplies, the Survey's activities are now becoming rather highly specialized and during the past year it has disposed of many projects that were submitted for consideration. Such projects, of course, are discussed publicly, and once again the application of geology to such problems is rather forcefully brought out.

The increasing interest in the Survey's water-well work is shown by the fact that in 1935 approximately 12,000 individual samples were received; in 1936 the intake was approximately 24,000 and in 1937 34,000 individual samples were received. Most of these samples represent voluntary contributions on the part of well drilling contractors, although on wells drilled for municipal water supplies contractors are required by the State Board of Health to supply well samples to the Survey. The Survey maintains a mineral exhibit at the State Fair, which annually draws large crowds. Also, each employee of the Survey has been instructed by the director, Dr. Buehler, to always thoroughly explain to anyone interested the object of their investigations, and the practical application of geology in every-day life.

In addition to the work of the Missouri State Survey, McQueen also gave talks before various societies, organizations, and schools. These talks range in scope from those of a general nature to those dealing specifically with some geological problem.

McQueen also reports that members of the Department of Geology at

Washington University have delivered addresses on certain phases of geology over radio station KSD, St. Louis, Missouri.

Following the publication of the 1936 report, A. C. Tester, of the Iowa Geological Survey, advised that they have been doing good work in advancing interest in geology and demonstrating its application to the every-day life of the people. In particular, they have emphasized the importance of geology to the development of underground water supplies, including even the farm and small domestic well supplies.

Earl A. Trager, chief, Naturalist Division, of the National Park Service in Washington, D. C., reports that the important work of the Park Service in publicizing geology continues to show progress and results.

The Park Service have issued booklets which describe the important features in many of the National Parks and Monuments, and for those parks here listed, there has been included a geologic section in each of these booklets.

Acadia National Park
Crater Lake National Park
Carlsbad Caverns National Monument
Death Valley National Park
Glacier National Park
Grand Canyon National Park
Grand Teton National Park
Hawaii National Park
Hot Springs National Park

Lassen Volcanic National Park
Mt. McKinley National Park
Mount Rainier National Park
Shenandoah National Park
Wind Cave National Park
Yellowstone National Park
Zion National Park
Bryce National Park

A graduate geologist, capable of making very excellent block diagrams, was added to the personnel of the Park Service. Some of these diagrams have been enlarged to illustrate the complex geologic features in such manner as to be understandable to the public. Installation of such diagrams was made at Thermopolis Hot Springs in Wyoming, the Longhorn Caverns, Texas, and is proposed for the Platt National Park and Big Bend National Park.

During the past year, the Park Service completed, in cooperation with the United States Geological Survey, a series of maps and drawings for Glacier National Park, illustrating the general geology and the story of the glaciers.

A guide book for the Shenandoah National Park has been prepared covering the route along the Skyline Drive from Washington westward to the Shenandoah Valley, and back through the valley to the east. This is designed so that it may be used by the visitor in either direction, from or to Washington. This guide book is accompanied by approximately twenty drawings and several photographs. The first is a large block diagram which orients the visitor geologically from Washington across the coastal plain over the Fall line; thence across the Piedmont Plateau and finally into the Blue Ridge proper. Twenty points of interest are indicated along the route, and it is hoped that these will be numbered by a small marker of some kind so that they will be easily found by visitors travelling this road. Unfortunately, no provision to date has been made for free distribution of this guide book, but it is hoped that some way will be found in the future to distribute this book to visitors to the park.

A chart has been prepared for display in the important geologic areas, giving a graphic representation of geologic time. Another chart classifies the important geologic features in the National Parks and Monuments. A third chart has been prepared which indicates what portion of the geologic column is exposed in the various parks and monuments, and by appropriate symbol

indicates whether these are glacial, volcanic, sedimentary or metamorphic. A similar chart is now in the course of preparation which will contain an actual stratigraphic column for each park and monument, containing noteworthy geologic examples.

Ten radio broadcasts are now in rough-draft form, which when completed will be sent to broadcasting stations for fill-in programs. These broadcasts will explain the relationship between geology and the scenic features of our National Parks and Monuments.

In addition to these specific instances of major displays, there was prepared during the past year a great many lesser exhibits for use on signs along trails, as labels, or as explanatory statements of museum exhibits.

It is quite evident from the foregoing brief statements regarding the work of the National Park Service, that it is doing an excellent work in publicizing geology. It is also interesting to note the increase in attendance the past few years to our National Parks. In 1932 there were approximately 3,000,000 visitors, whereas in the past year more than 15,000,000 visited the parks, and of these more than 4,000,000 took advantage of the guided trips or lectures given within the parks.

As a part of the activities of the committee, the chairman enlisted the services of several members of the Association to supply W.A.J.M. van der Gracht with a fair representative collection of American crude oils and samples, preferably in the form of cores of American oil sands, presumable source rocks and other stratigraphically interesting samples of rocks associated with oil deposits of the United States. Van der Gracht desired this collection for purposes of research and finally to make of it a permanent museum exhibit.

In April, 1937, Dr. Lowell R. Laudon of the University of Tulsa and his class in paleontology discovered a colony of trilobites in the Arbuckle Mountains, Oklahoma. Considerable justified publicity was given this find by the Tulsa newspapers. Laudon was quoted as follows.

The most valuable paleontological discovery made in the past fifty years in this country. The find can not be evaluated in dollars and cents but we can trade them with other universities and museums for anything we want. This is the first time trilobites have been found in a colony and we lifted out hundreds of perfect specimens.

The chairman of this committee solicits from each member of the Association his cooperation in bringing geology to the attention of the people in its application and value to every-day life and living, and suggests that he report his activities frequently in order to coördinate and unify the efforts to the best advantage.

FRANK R. CLARK, *chairman*

EXHIBIT VIII. REPORT OF COMMITTEE FOR PUBLICATION

I wish to report to you on the activities of the committee for publication, a committee which was organized last spring, and the function of which is to encourage the writing of papers for the *Bulletin* by Association members. In no sense was this committee to serve in an editorial capacity.

The committee includes 23 members who were chosen for their recognized interest in Association matters; and they were selected in various parts of the United States in order to give the committee a representative distribution. Most of the members have been really interested in their work, and have ac-

complished a great deal. Their replies to a letter which I sent out in January show that, although up to the end of 1937 only three papers solicited by them have been published in the *Bulletin*, 46 papers have been written, or are nearing completion, and 35 or 40 more are suggested as possible. More than half the papers actually finished or in preparation are intended for presentation at the New Orleans meeting.

In these same replies a few suggestions were offered. One of the members said that papers for the *Bulletin* should probably first be read and discussed before the local societies, before offering them to the editorial board. Two members felt that each person serving on the committee should be made responsible for securing a brief description of pertinent data on each new discovery well and the structure on which it is located. Another member indicated that the regional editor in his district had "gone stale" and that new life should be brought into the editorial staff by appointment of regional editors every 3 years. I am reciting these ideas since I believe they are worthy of careful consideration both by the incoming editor and by the next chairman of this committee.

In closing, may I express my personal thanks to all members of the committee for their earnest and conscientious efforts in behalf of the Association.

FREDERIC H. LAHEE, *chairman*

EXHIBIT IX. REPORT OF REPRESENTATIVE TO NATIONAL RESEARCH COUNCIL

In accordance with the custom started a few years ago I wish to submit for your approval my report to the Association as its representative on the Division of Geology and Geography of the National Research Council. The Division held its annual meeting on May 1, 1937, in Washington, D. C. At this meeting I was again serving in place of R. S. Knappen, resigned, whose term would have been completed at this time.

Details concerning the nature and functions of the National Research Council, and particularly of its Division of Geology and Geography, and the relations of the interests of this Division to our own Association, may be found in previous reports of your representative, on pp. 661-663, Vol. 20, and on pp. 678-680, Vol. 21, of the *Association Bulletin*.

Last May further summaries of work accomplished by the numerous committees of the Division were presented for discussion. I shall briefly mention those which seem to be of most interest to our own members.

The committee on tectonics (C. R. Longwell, chairman) reported the appearance of the structural map of Texas, accompanying Vol. II of *Geology of Texas*, published by the Bureau of Economic Geology at Austin. It described this as covering one of the largest areas ever included on a tectonic map. It cited also the publication of the tectonic map of Southern California. This committee is working toward the ultimate goal of a good tectonic map of the entire United States. Association members serving on this committee are C. H. Behre, Philip B. King, A. I. Levorsen, T. S. Lovering, R. D. Reed, and W. T. Thom, Jr.

Dr. Jos. A. Cushman, chairman of the committee on micropaleontology, referred to the importance of Piggot's method of securing ocean-bottom cores up to 10 or 12 feet in length. Piggot's apparatus employs an explosive as the driving force for punching out a core from the bottom sediments. A similar

machine, using the pressure of depth as the actuating force, instead of an explosive, is being used off the California coast by Varney and Redwine, who have succeeded in obtaining samples of Miocene strata from the sea floor. Dr. Cushman urged "the study of the faunas of definite type localities," and also extension of this study to Europe, "for many of the formations in Europe are very important in the correlation of formations of America and elsewhere." He called attention to the erosional release, reworking, and redeposition of microfossils, often without injury, so that later formations may be miscorrelated by their content of older fossils unless great care is taken. Association members of this committee are Carey Croneis, J. A. Cushman, Alva C. Ellisor, G. D. Hanna, Henry V. Howe, and R. C. Moore.

Dr. Parker D. Trask, chairman of the committee on sedimentation, submitted a proposed schedule of papers for a symposium on recent sediments. This is quite comprehensive and includes contributions from various parts of the world. I do not know the state of progress of the writing. Association members of Trask's committee are E. Blackwelder, M. N. Bramlette, M. I. Goldman, M. M. Leighton, H. B. Milner, R. D. Russell, W. A. Tarr, A. C. Tester, P. D. Trask, A. C. Trowbridge, W. H. Twenhofel, and T. Wayland Vaughan.

The committee on conservation of the scientific results of drilling, through its chairman, A. C. Tester, reported some progress in gathering samples from drilled wells. In particular Dr. Sellards reported accumulation of a large number of well samples from parts of Texas, these samples being housed at Austin and, as I understand, being made available for examination by students at the University. It would seem that State surveys offer the best facilities for storing such samples. Collection and shipping of the materials to the repositories depend largely on the interest and generosity of organizations drilling the wells. Association members on this committee are M. A. Hanna, F. H. Lahee, H. S. McQueen, O. E. Meinzer, E. H. Sellards, A. C. Tester, and W. T. Thom, Jr.

Dr. C. R. Longwell is now chairman of the Division. If any of our Association members are interested to learn more of special phases of the work of the committees, I am sure he will be glad to assist them.

Last year we received information concerning certain post-doctorate fellowships in the natural sciences, made available by the National Research Council, but this information came too late to reach our membership. This year notice of these fellowships was printed in our January *Bulletin* on p. 125, under "At Home and Abroad." If any of our members are interested in applying for these fellowships, I suggest that they make early inquiry for next year.

FREDERIC H. LAHEE

EXHIBIT X. REPORT OF RESOLUTIONS COMMITTEE

BE IT RESOLVED, That we, the members of the American Association of Petroleum Geologists, express our appreciation and sincere thanks to the Shreveport Geological Society and the South Louisiana Geological Society and to all those who have worked and contributed to the success of our twenty-third annual meeting and particularly to the following.

Professor R. A. Steinmayer, general chairman of the convention committee and all other chairmen and members of his committee.

Mrs. R. A. Steinmayer, chairman, and other members of the ladies committee.

New Orleans Association of Commerce.

Honorable Commissioner Jesse S. Cave, who represented the State of Louisiana and the City of New Orleans.

Honorable Commissioner William G. Rankin of the Louisiana State Department of Conservation.

Tulane University and Dr. Rufus C. Harris, its president.

The many oil, industrial, and supply companies, whose advertising in the entertainment program financed much of the local expense, and the exhibitors for their excellent displays.

The following civic, technical, and educational organizations for inviting members of our Association to address their meetings and thereby giving us the opportunity to explain to their members some of the functions of petroleum geology.

Louisiana Engineering Society
Lions Club
Kiwanis Club
Tulane University, College of Commerce
Rotary Club
Young Men's Business Club
Co-operative Club
Member's Council of the Association of Commerce
Recess Club

The New Orleans Public Service Corporation and the New Orleans press and the trade journals for the publicity which they have given us.

Mr. and Mrs. William H. McFadden for the use of their home for the ladies' tea.

The New Orleans Country Club for the use of their links for the golf tournament and to those who so generously furnished golf trophies.

The Roosevelt Hotel management for their coöperation and for generously placing at our disposal rooms and other facilities for holding our meetings.

Those who donated flowers and favors for the ladies' entertainment and the members of the double quartet of Newcomb College for their entertainment.

Mr. Sam Fowlkes, Sr., director of the Convention and Visitor's Bureau of the Association of Commerce, for the personal interest which he has taken in making this convention a success.

Mr. Steffey and Miss Gertrude Brown and her staff from the Association of Commerce for preparing a registration list.

BE IT FURTHER RESOLVED, That the sincere thanks of the Association be given to the executive committee for the successful manner in which they have conducted the affairs of the Association during the past year.

BE IT FURTHER RESOLVED, That these resolutions be included in the minutes of the meeting and copies be sent to the individuals and organizations named.

ALEXANDER DEUSSEN, *chairman*
ROLF MCCOLLOM
A. I. LEVORSEN

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

CONSTITUTION AND BY-LAWS

(Adopted 1918 and amended 1921, 1922, 1923, 1925, 1927, 1928, 1929, 1930,
1932, 1933, 1935, and 1936)

CONSTITUTION

ARTICLE I. NAME

This Association shall be called "The American Association of Petroleum Geologists," incorporated under the laws of Colorado the 21st day of April, 1924, for a period of twenty (20) years.

ARTICLE II. OBJECT

The object of this Association is to promote the science of geology, especially as it relates to petroleum and natural gas; to promote the technology of petroleum and natural gas and to encourage improvements in the methods of exploring for and exploiting these substances; to foster the spirit of scientific research amongst its members; to disseminate facts relating to the geology and technology of petroleum and natural gas; to maintain a high standard of professional conduct on the part of its members; and to protect the public from the work of inadequately trained and unscrupulous persons posing as petroleum geologists.

ARTICLE III. MEMBERSHIP

Members

SECTION 1. Any person engaged in the work of petroleum geology or in research pertaining to petroleum geology or technology is eligible to active membership, provided he is a graduate of an institution of collegiate standing, in which institution he has done his major work in geology, or in sciences fundamental to petroleum geology, and in addition has had the equivalent of three years' experience in petroleum geology or in the application of these other sciences to petroleum geology or to research in petroleum geology or technology; and provided further that in the case of an applicant for membership who has not had the required collegiate or university training, but whose standing in the profession is well recognized, he shall be admitted to membership when his application shall have been favorably and unanimously acted upon by the executive committee; and provided further that these requirements shall not be construed to exclude teachers and research workers in recognized institutions, whose work is of such character as in the opinion of the executive committee shall qualify them for membership.

Active members alone shall be known as members.

Life Members

SECTION 2. The executive committee may grant life membership to members who have paid their dues and are otherwise qualified.

Associates

SECTION 3. Any person having completed as much as thirty hours of geology (an hour shall here be interpreted as meaning as much as sixteen recitation or lecture periods of one hour each, or the equivalent in laboratory) in a reputable institution of collegiate or university standing, or who has done field work equivalent to this, is eligible to associate membership, provided at the time of his application for membership he shall be engaged in geological studies in an institution of collegiate or university standing, or shall be engaged in petroleum geology; and any person who is a graduate of an institution of collegiate standing in which he has done his major work in sciences fundamental to petroleum geology or petroleum technology, and who has the equivalent of one year's experience in the application of his science to the study of petroleum geology, shall be eligible to associate membership, provided at the time of his application for membership he shall be engaged in investigations in the broader subject of petroleum geology and technology.

Associate members shall be known as associates.

Associates shall enjoy all the privileges of membership in the Association, save that they shall not hold office, sign applications for membership, or vote; neither shall they have the privilege of advertising their affiliation with the Association in professional cards or professional reports or otherwise.

The executive committee may advance to active membership, without the formality of application for such change, those associates who have, subsequent to election, fulfilled the requirements for active membership.

Election to Membership

SECTION 4. Every candidate for admission as a member or associate shall submit a formal application on an application form authorized by the executive committee, signed by him, and endorsed by not less than three members who are in good standing, stating his training and experience and such other facts as the executive committee shall from time to time prescribe. Provided the executive committee, after due consideration, shall judge that the applicant's qualifications meet the requirements of the constitution, they shall cause to be published in the *Bulletin* the applicant's name and the names of his sponsors. If, after at least thirty days have elapsed since such publication, no reason is presented why the applicant should be not admitted, he shall be deemed eligible to membership or to associate membership, as the case may be, and shall be notified of his election.

SECTION 5. An applicant for membership, on being notified of his election in writing, shall pay full membership dues for the current year and on making such payment shall be entitled to receive the entire *Bulletin* for that year. Unless payment of dues is made within thirty (30) days by those living within the continental United States and within ninety (90) days by those living elsewhere, after notice of election has been mailed, the executive committee may rescind the election of the applicant. Upon payment of dues, each applicant for membership shall be furnished with a membership card for the current year, and until such written notice and card are received, he shall in no way be considered a member of the Association.

Honorary Members

SECTION 6. The executive committee may from time to time elect as honorary members persons who have contributed distinguished service to the

cause of petroleum geology. Honorary members shall not be required to pay dues.

ARTICLE IV. OFFICERS AND THEIR DUTIES

Officers

SECTION 1. The officers of the Association shall be a president, a vice-president, a secretary-treasurer, and an editor. These, together with the past president, shall constitute the executive committee and managers of the Association.

SECTION 2. The officers shall be elected annually from the Association at large by written ballot deposited in a locked ballot box by those members, present at the annual meeting, who have paid their current dues and are otherwise qualified under the constitution. Each candidate, when voted for as a candidate for the particular office for which he is nominated, shall be thereby automatically voted for as a candidate for the executive committee for one year, except that candidates for the presidency shall be automatically voted for as candidate for the executive committee for two years.

SECTION 3. No one shall hold the office of president for two consecutive years and no one shall hold any other office for more than two consecutive years except the editor who shall not hold office for more than six consecutive years.

Duties of Officers

SECTION 4. The president shall be the presiding officer at all meetings of the Association, shall take cognizance of the acts of the Association and of its officers, shall appoint such committees as are required for the purposes of the Association, and shall delegate members to represent the Association. He may, at his option, serve on, and may be chairman of, any committee.

SECTION 5. The vice-president shall assume the office of president in case of a vacancy from any cause in that office and shall assume the duties of president in case of the absence or disability of the latter.

SECTION 6. The secretary-treasurer shall assume the duties of president in case of the absence of both the president and vice-president. He shall have charge of the financial affairs of the Association and shall annually submit reports as secretary-treasurer covering the fiscal year. He shall receive all funds of the Association, and, under the direction of the executive committee, shall disburse all funds of the Association. He shall cause an audit to be prepared annually by a public accountant at the expense of the Association. He shall give a bond, and shall cause to be bonded all employees to whom authority may be delegated to handle Association funds. The amount of such bonds shall be set by the executive committee and the expense shall be borne by the Association. The funds of the Association shall be disbursed by check as authorized by the executive committee.

SECTION 7. The editor shall be in charge of editorial business, shall submit an annual report of such business, shall have authority to solicit papers and material for the *Bulletin* and for special publications, and, with the approval of the executive committee, may accept or reject material offered for publication. He may appoint associate, regional, and special editors.

SECTION 8. The officers shall assume the duties of their respective offices immediately after the annual meeting in which they are elected.

ARTICLE V. EXECUTIVE COMMITTEE—MEETINGS AND DUTIES

Executive Committee

SECTION 1. The executive committee shall consist of the president, past-president, vice-president, secretary-treasurer, and editor.

Meetings and Duties

SECTION 2. The executive committee shall meet immediately preceding the annual meeting and at the call of the president may hold meetings when and where thought advisable, to conduct the affairs of the Association. A joint meeting of the outgoing and incoming executive committees shall be held immediately after the close of the annual Association business meeting. Members of the executive committee may vote by proxy on matters which require a unanimous vote.

SECTION 3. The executive committee shall consider all nominations for membership and pass on the qualifications of the applicants; shall have control and management of the affairs and funds of the Association; shall determine the manner of publication and pass on the material presented for publication; and shall designate the place of the annual meeting. They are empowered to establish a business headquarters for the Association, and to employ such persons as are needed to conduct the business of the Association. They are empowered to accept, create, and maintain special funds for publication, research, and other purposes. They are empowered to make investments of both general and special funds of the Association. Trust funds may be created, giving to the trustees appointed for such purpose, such direction as to investments as seems desirable to the executive committee to accomplish any of its objects and purposes, but no such trust funds shall be created unless they are revocable upon ninety (90) days' notice.

ARTICLE VI. MEETINGS

The Association shall hold at least one stated meeting each year, which shall be the annual meeting. This meeting shall be held in March at a time and place designated by the executive committee. At this meeting the election of members shall be announced, the proceedings of the preceding meeting shall be read, Association business shall be transacted, scientific papers shall be read and discussed, and officers for the ensuing year shall be elected.

ARTICLE VII. AMENDMENTS

Amendments to this constitution may be proposed by a resolution of the executive committee, by a constitutional committee appointed by the president, or in writing by any ten members of the Association. All such resolutions or proposals must be submitted at the annual meeting of the business committee of the Association as provided in the by-laws, and only the business committee shall make recommendations concerning proposed constitutional changes at the annual Association business meeting. If such recommendations by the business committee shall be favorably acted on at the annual Association business meeting, the secretary-treasurer shall arrange for a ballot of the membership by mail within thirty (30) days after said annual Association business meeting, and a majority vote of the ballots received within ninety (90) days of their mailing shall be sufficient to amend. The legality of all amendments must be determined by the executive committee prior to balloting.

BY-LAWS

ARTICLE I. DUES

SECTION 1. The fiscal year of the Association shall correspond with the calendar year.

SECTION 2. The annual dues of members of the Association shall be ten dollars (\$10.00). The annual dues of associates for not to exceed three years after election shall be six dollars (\$6.00); for the second three-year period eight dollars (\$8.00); thereafter, the annual dues of such associates shall be ten dollars (\$10.00). The annual dues are payable in advance on the first day of each calendar year. A bill shall be mailed to each member and associate before January first of each year, stating the amount of the annual dues and the penalty and conditions for default in payment. Members or associates who shall fail to pay their annual dues by April first shall not receive copies of the April *Bulletin* or succeeding *Bulletins*, nor shall they be privileged to buy Association special publications at prices made to the membership, until such arrears are met.

SECTION 3. On the payment of two hundred dollars (\$200.00) any member in good standing shall be declared a life member and thereafter shall not be required to pay annual dues. The funds derived from this source shall be placed in a permanent investment, the income from which shall be devoted to the same purposes as the regular dues.

ARTICLE II. RESIGNATION—SUSPENSION—EXPULSION

SECTION 1. Any member or associate may resign from the Association at any time. Such resignation shall be in writing and shall be accepted by the executive committee, subject to the payment of all outstanding dues and obligations of the resigning member or associate.

SECTION 2. Any member or associate who is more than a year delinquent (in arrears) in payment of dues shall be suspended from the Association. Any delinquent or suspended member or associate, at his own option, may request in writing that he be dropped from the Association and such request shall be granted by the executive committee. Any member or associate more than two years in arrears shall be dropped from the Association. The time of payment of delinquent dues for either one year or two years may be extended by unanimous vote of the executive committee.

SECTION 3. Any member or associate who resigns or is dropped under the provisions of Sections 1 and 2 of this article ceases to have any rights in the Association and ceases to incur further indebtedness to the Association.

SECTION 4. Any person who has ceased to be a member or associate under Section 1 or Section 2 of this article may be reinstated by unanimous vote of the executive committee subject to the payment of any outstanding dues and obligations which were incurred, prior to the date when he ceased to be a member or associate of the Association.

In the case of any member or associate who has been dropped between the dates of January 1, 1931, and January 1, 1936, for non-payment of dues and who shall apply for reinstatement, the executive committee is authorized, at its discretion, to accept the resignation of such member or associate effective at any date during such period of delinquency, provided, the member shall pay all indebtedness to the Association incurred prior to the date of

such resignation including a proper proportion of annual dues as shall be fixed by the executive committee. Such member or associate shall not be entitled to receive the *Bulletin* for any period subsequent to the date when his resignation became effective and prior to his reinstatement.

SECTION 5. Any member or associate who, after being granted a hearing by the executive committee, shall be found guilty of a violation of the code of ethics of this Association or shall be found guilty of a violation of the established principles of professional ethics, or shall be found guilty of having made a false or misleading statement in his application for membership in the Association, may be suspended or expelled from the Association by unanimous vote of the executive committee. The decision of the executive committee in all matters pertaining to the interpretation and execution of the provisions of this section shall be final.

ARTICLE III. PUBLICATIONS

SECTION 1. The proceedings of the annual meeting and the papers presented at such meeting shall be published at the discretion of the executive committee in the Association *Bulletin* or in such other form as the executive committee may decide best meets the needs of the membership of the Association.

SECTION 2. The payment of annual dues for any fiscal year entitles the member or associate to receive without further charge a copy of the *Bulletin* of the Association for that year.

SECTION 3. The executive committee may authorize the printing of special publications to be financed by the Association from its general, publication, or special funds and offered for sale to members and associates in good standing at not less than cost of publication and distribution.

ARTICLE IV. REGIONAL SECTIONS, TECHNICAL DIVISIONS, AND AFFILIATED SOCIETIES

SECTION 1. Regional sections of the Association may be established provided the members of such sections are members of the Association and shall perfect an organization and make application to the executive committee. The executive committee shall submit the application to a vote at a regular annual meeting, an affirmative vote of two-thirds of the members present and voting being necessary for the establishment of such a section; and provided that the Association may revoke the charter of any regional section by a vote of two-thirds of the members present and voting at a regular annual meeting.

SECTION 2. Technical divisions may be established, provided the members interested shall perfect an organization and make application to the executive committee. The executive committee shall submit the application to a vote at a regular meeting, an affirmative vote of two-thirds of the membership present and voting being necessary for the establishment of such a division. In like manner, the Association may dissolve a division by an affirmative vote of two-thirds of the members present and voting at any annual meeting. A technical division may have its own officers, and it may have its own constitution and by-laws provided that, in the opinion of the executive committee,

these do not conflict with the constitution and by-laws of the Association. The executive committee shall be empowered to make arrangements with the officers of the division for the conduct of the business of the division. A division may admit to affiliate membership in the division specially qualified persons who are not eligible to membership in the Association. Technical divisions may affiliate with other scientific societies, with the approval of the executive committee.

SECTION 3. Subject to the affirmative vote of two-thirds of the membership present and voting at an annual meeting, and with legal advice, the executive committee may arrange for the affiliation with the Association of duly organized groups or societies, which by objects, aims, constitution, by-laws, or practice are developing the study of geology or petroleum technology. In like manner and with like advice, the executive committee may arrange conditions for dissolution of such affiliations. Affiliation with the Association need not prevent affiliation with other scientific societies. Members of affiliated societies who are not members of the Association, shall not have the privilege of advertising their affiliation with the Association on professional cards or otherwise.

ARTICLE V. DISTRICT REPRESENTATIVES

The executive committee shall cause to be elected district representatives from districts which it shall define by a local geographic grouping of the membership. Such districts shall be redesignated and redefined by the executive committee as often as seems advisable. Each district shall be entitled to one representative for each seventy-five members, but this shall not deprive any designated district of at least one representative. The representatives so apportioned shall be chosen from the membership of the district by a written ballot arranged by the executive committee. They shall hold office for two years, their term of office expiring at the close of the annual meeting.

ARTICLE VI. BUSINESS COMMITTEE

There shall be a business committee to act as a council and advisory board to the executive committee and the Association. This committee shall consist of the executive committee, not more than five members at large appointed by the president, two members elected by and from each technical division, and the district representatives. The president shall also appoint a chairman and a vice-chairman, but neither of these need be one of those otherwise constituting the business committee. The secretary-treasurer shall act as secretary of the business committee. If a district or technical representative is unable to be present at any meeting of the committee he may designate an alternate, who, in the case of a district representative, may or may not be a resident of the district he is asked to represent, and the alternate, on presentation of such a designation in writing, shall have the same powers and privileges as a regularly chosen representative. The business committee shall meet the day before the annual meeting at which all proposed changes in the constitution or by-laws shall be considered, all old and new business shall be discussed, and recommendations shall be voted for presentation at the annual meeting.

ARTICLE VII. AMENDMENTS

These by-laws may be amended by vote of three-fourths of the members present and voting at any annual meeting, provided that such changes shall have been recommended to the meeting by the business committee and provided that their legality shall be determined by the executive committee prior to publication.

MID-YEAR MEETING, EL PASO, TEXAS
SEPTEMBER 27-OCTOBER 2, 1938

The mid-year meeting of the Association will be held in El Paso, Texas, at the invitation and under the sponsorship of the West Texas Geological Society, and with the coöperation of the El Paso chapter of the American Institute of Mining and Metallurgical Engineers, the New Mexico Geological Society, the South Texas Geological Society, the College of Mines and Metallurgy of the University of Texas, and the New Mexico School of Mines. Field trips are being planned for September 27-28 and October 1-2 to include excursions in Mexico and the United States, some of which will have considerable bearing on stratigraphic problems of development in West Texas. The technical program will be presented on September 29-30.

ASSOCIATION COMMITTEES

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 IRA H. CRAW, *secretary*, Tulsa, Oklahoma HAROLD W. HOOTS, Los Angeles, California
 W. A. VER WIEBE, Wichita, Kansas

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Memorial

DALE DARRELL DOLSUN SPARKS (1894-1938)

Dale Darrell Dolsun Sparks died on March 17, 1938, at the Numune Hospital of Ankara, Turkey, after a brief illness of meningitis. He had recuperated from a mild attack of cold when he was taken ill again. Two days later his condition necessitated a consultation when four doctors attended him and decided to remove him to the hospital. There the cause of the disease was identified as *Pneumococcus meningitis*. He was three days in the hospital, during the last two of which he was in a coma.

Dale Sparks joined the Petroleum Division of the M.T.A. Institute, January 1, 1938. In the short time he was in the Institute his fellow workers learned to respect his knowledge and esteem his personality. The funeral was attended by all the members of the Institute; Turk, American, German, Swiss, French, and Russian followed the body to the United States Embassy where an appropriate address was made by the director of the petroleum group.

Dale Sparks was born in Marengo, Indiana, April 6, 1894. He went to Valparaiso, Indiana, public schools. He attended Valparaiso University, Valparaiso, Indiana, from 1911 to 1917, when he received the degrees of B.S. in pharmaceutical chemistry, and Ph.D. He taught qualitative analysis, organic chemistry, while in the University. During the World War he was United States Army chemist in charge of Chlorine Plant Laboratory, Edgewood, Maryland. From 1920 to 1924 he attended Leland Stanford University, Palo Alto, California, where he obtained the degrees, A.B. and M.A. in geology and paleontology.

He entered the services of Cia de Gasy Combustible "Imperio" of Tampico, Mexico, in 1924, where he established one of the earliest micropaleontological laboratories in Mexico and did joint work for the Sinclair and the Empire companies and was responsible for several profitable locations for these companies. He left the services of the Empire in 1931 and was retained as a consultant by the Sinclair until 1935, when he entered private practice as geologist and paleontologist. He did considerable work on the Angelina arch in Louisiana and secured well located acreage. Ten days before his death he received the good news of an important well on his property.

He married the second time in 1935, and settled in Houston, Texas. He was a thirty-second degree Mason, a member of the Shrine, and a member of the American Association of Petroleum Geologists since 1927. He had a brilliant and methodical mind. Those who knew him closely respected his abilities and valued him as a friend.

CEVAT EYUP TAŞMAN

ANKARA, TURKEY
March 17, 1938

AT HOME AND ABROAD

CURRENT NEWS AND PERSONAL ITEMS OF THE PROFESSION

C. B. McCLINTOCK, Oil City, Pennsylvania, has been engaged by the University of Pittsburgh to deliver one lecture a week to the senior students of petroleum engineering.

PAUL H. BOOTS may be addressed in care of the Gulf Exploration Company, 3 London Wall Building, London, E. C. 2, England.

M. T. HARTWELL, formerly with The Texas Company, Fort Worth, has accepted a position as district geologist for the Mid-Continent Petroleum Corporation at Abilene.

RICHARD E. SHERRILL, University of Pittsburgh, spoke before a meeting of Pennsylvania producers at Oil City, March 25, on the subject, "The Geology of the Oil and Gas Fields of the Tidioute Quadrangle."

SHAPLEIGH G. GRAY, The Texas Company, Shreveport, has resigned to accept a position with the Tide Water Associated Oil Company at Houston.

HENRY B. SCHUYLER may be addressed at Société California Egyptienne des Petroles, 37 Sharia Kasr el Nil, Cairo, Egypt.

WILLIAM W. PORTER, Los Angeles, is the instructor in a new course in practical oil geology offered by the University of California extension division.

ERIC K. CRAIG, formerly geologist for the Shell Oil Company in the Rocky Mountain region, has resigned to open a private office in Bakersfield, California.

FRANK S. HUDSON, Los Angeles, has been appointed chief geologist for the Shell Oil Company to succeed Angus McLeod, who resigned to enter consulting geological practice.

PAUL J. FLY is chief geologist and head of the land and scouting department of Texas and Louisiana Crusader Oil, Inc., 2706 Gulf Building, Houston, Texas.

The members of the Tulsa Geological Society were guests of LUTHER H. WHITE, April 4, at an illustrated talk by J. ELMER THOMAS about his trip through Russia.

R. L. HEATON spoke before the Rocky Mountain Association of Petroleum Geologists, April 4, on the subject, "New Developments in the Jurassic in the Rocky Mountain Region."

H. J. HAWLEY, Dallas, Texas, has been transferred to San Francisco to become manager of the exploration division of the production department of the Standard Oil Company of California.

Officers of the Society of Exploration Geophysicists are: president, F. M. KANNENSTINE, Kannenstine Laboratories, Houston; vice-president, W. T.

BORN, Geophysical Research Corporation, Tulsa; editor, M. M. SLOTNICK, Humble Oil and Refining Company, Houston; secretary-treasurer, H. B. PEACOCK, Geophysical Service, Inc., Houston.

At a meeting of the Tulsa Geological Society, April 11, EDWARD A. KOESTER presented a paper, "Subsurface Geology of Western Kansas."

ORVAL L. BRACE spoke before the Houston Geological Society, March 21, on the subject, "Oil Development in the Gulf Coast during 1937."

J. O. G. SANDERSON was recently named president of the Association of Professional Engineers of Alberta.

LINN M. FARISH, Ardmore, Oklahoma, recently discussed the Seventeenth International Geological Congress held at Moscow, July-August, 1937, before a meeting of the Shawnee Geological Society.

JOHN P. BUWALDA spoke before the Southern California section of the A.I.M.E. at Los Angeles, February 16, on the subject, "Fault Structure of Southern California."

JOHN D. MARR has joined the staff of the Seismic Explorations, Inc., at Houston.

G. F. KAUFMANN, formerly with the Huasteca Petroleum Company in Mexico, is now in charge of geophysical exploration for the Standard Oil Company of Venezuela at Caripito.

BAILEY WILLIS spoke before the San Francisco section of the A.I.M.E., March 19, on the subject, "Geology of the Philippine Archipelago and Relation of Structure to the Mineralized Zones of the Islands."

LESTER A. LUECKE, petroleum geologist, who has spent the last 10 years with the Gulf Companies in North and South America, has opened a consulting office in the Harvey-Snyder Building, Wichita Falls, Texas. Luecke led the expedition into the Barco Concession in 1931 when the Mellon interests regained title to the concession.

At a meeting of the Appalachian Geological Society in Charleston, West Virginia, April 11, the papers delivered at the convention of the American Association of Petroleum Geologists in New Orleans by PAUL PRICE, State geologist of West Virginia, and J. R. LOCKETT, Ohio Fuel Gas Company, were read.

The annual field trip, sponsored by the Appalachian Geological Society and including the faculty and students of the University of Kentucky, the University of Cincinnati, Miami University, and the University of West Virginia, was held April 29 to May 1. On this trip the Pine Mountain and Russell Fork Fault area was studied at the Breaks of the Big Sandy River. A. C. MCFARLAN, University of Kentucky, and JOHN L. RICH, University of Cincinnati, were in charge of the trip.

LESLIE A. FISHER, Sinclair Prairie Oil Company, Houston, was killed April 1, at Galveston, when his car skidded into the causeway railing.

T. E. SWIGART, Shell Petroleum Corporation, St. Louis, sailed on April 14 to go to The Hague for several months.

The Shawnee Geological Society sponsored a field tour to the east-central Oklahoma area of Pottawatomie, Seminole, and Hughes counties on April 2. ROBERT H. DOTT, director of the Oklahoma Geological Survey, outlined the stratigraphy of the region at a meeting of the society, April 1. Others on the program were the following: DARSIE A. GREEN, Pure Oil Company, Tulsa, and MALCOLM C. OAKES, Oklahoma Geological Survey, Norman, discussion of the Prague-Grayhorse-Neva series; OSCAR HATCHER, Ada, and A. N. MURRAY, Tulsa University, discussion of the Belle City limestone; J. L. BORDEN, Pure Oil Company, Tulsa, and ROY P. LEHMAN, Phillips Petroleum Corporation, Shawnee, discussion of the Francis-DeNay-Checkerboard series; HUBERT BALE, Oklahoma City, discussion of the Holdenville or Homer limestone; A. N. MURRAY, discussion of the Calvin-Wewoka strata. The leaders of the trip were A. M. MEYER, Atlantic Refining Company and president of the Shawnee Geological Society, ROBERT H. DOTT, and ROY P. LEHMAN. The group studied the beds on the surface and an effort was made to correlate the surface section with the subsurface and the Kansas sections.

J. E. HESTON, formerly with the Cities Service Oil Company at Hobbs, New Mexico, may now be addressed in care of Petroleum Advisers, Inc., 60 Wall Tower, New York City.

LEMOYNE W. MEYERS may be addressed in care of The Caribbean Petroleum Company, Maracaibo, Venezuela, S.A.

E. B. BRANSON, of University of Missouri, discussed, "The Lower Mississippian of the Mississippi Valley," before the Tulsa Geological Society, May 2.

J. BRIAN EBY talked before the South Louisiana Geological Society, at Lake Charles, February 21, on the "Relations of Geological and Geophysical Exploration to Petroleum Reserves." On April 18, H. V. HOWE, of Louisiana State University, gave the Society a summary, supplemented by numerous lantern slides, of his trip to Russia last summer to attend the Geological Congress at Moscow, and BENJAMIN CRAFT, also of Louisiana State University, newly elected secretary-treasurer of the Petroleum Division of the A. I. M. E., gave an outline of that body's activities and plans for their fall meeting at San Antonio.

The mid-year meeting of the Association will be in El Paso, Texas, September 27-October 2, at the invitation of the West Texas Geological Society.

MEMBERSHIP APPLICATIONS APPROVED
FOR PUBLICATION

(Continued from page 576)

Victor Timothy Stringfield, Washington, D. C.
Herman Gunter, H. V. Howe, Henry N. Toler
Benton R. Vernon, Shreveport, La.
A. M. Lloyd, William M. Barret, Shapleigh G. Gray

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James Burt Anderson, Glendale, Calif.
F. Wayne Galliher, U. S. Grant, E. K. Soper
Robert G. Anderson, Abilene, Tex.
K. B. Nowels, E. F. Boehms, Robert H. Cuyler
A. R. V. Arellano, Mexico, D. F. Mexico
Cecil Drake, S. A. Grogan, G. F. Kaufmann
Ray Artusy, Galveston, Tex.
A. J. Tiejie, John F. Dodge, Joseph Jensen
R. Stanley Beck, Bakersfield, Calif.
Charles E. Weaver, H. Allen Kelley, Rollin Eckis
Gilman A. Berg, Houston, Tex.
Gage Lund, W. H. Emmons, Clinton R. Stauffer
Kenneth George Boling, Olney, Ill.
Lynn K. Lee, L. J. Fulton, Willard Gill
Harvey Daniel Borger, Urbana, Ill.
F. W. DeWolf, Alfred H. Bell, Harold R. Wanless
Gilbert Todd Bowen, Taft, Calif.
G. C. Gester, W. P. Winham, W. F. Barbat
John Franklin Camp, Jr., San Antonio, Tex.
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B. E. Thompson, C. D. Cordry, H. M. Bayer
Joseph Horace Deming, Houston, Tex.
L. A. Scholl, Jr., J. N. Troxell, H. H. Arnold, Jr.
Rizer, Everett, Wichita, Kan.
Phil K. Cochran, Fred M. Bullard, Hal P. Bybee
Paul Bartlett Fahle, Houston, Tex.
J. Boyd Best, Fred M. Bullard, Robert H. Cuyler
David James Flesh, Jefferson, Tex.
L. A. Barton, Roy T. Hazzard, G. W. Schneider
Jack Jefferson Flowers, Houston, Tex.
Leroy T. Patton, M. A. Stainbrook, W. I. Robinson
Waldo Emerson Ford, Jr., Van Nuys, Calif.
Paul P. Goudkoff, A. J. Tiejie, R. E. Stewart
Lesh C. Forrest, Bakersfield, Calif.
Rollin Eckis, H. Allen Kelley, Drexler Dana
John Westlake Frink, Yonkers, N. Y.
Harold N. Fisk, Henry V. Howe, R. Dana Russell
Donald Thomas Gibson, Lubbock, Tex.
Leroy T. Patton, Raymond Sidwell, M. A. Stainbrook
Robert Keith Guthrie, Dallas, Tex.
Charles B. Carpenter, H. B. Hill, W. B. Berwald

- Edgar John Hagstette, Jr., Lafayette, La.
 R. A. Steinmayer, C. K. Moresi, Donald Goodwill, Jr.
 Charles Jacob Hoke, El Dorado, Ark.
 D. A. McGee, W. B. Weeks, H. R. Wanless
 John T. Isberg, Laramie, Wyo.
 Horace D. Thomas, W. T. Nightingale, W. B. Emery
 Earl Mathew Kipp, Midland, Tex.
 C. A. Mix, John Emery Adams, Harvey Hardison
 Fred Frank Kotyza, Midland, Tex.
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 Robert Scott Lamon, Ibague, Colombia, S.A.
 L. L. Tabor, T. J. Etherington, D. Jerome Fisher
 L. Kenneth Lancaster, Houston, Tex.
 Wayne V. Jones, W. H. Emmons, Clinton R. Stauffer
 Joseph LeConte, Bakersfield, Calif.
 Drexler Dana, Frank A. Morgan, H. W. Hoots
 John Lawrence Lester, Onarga, Ill.
 F. W. DeWolf, H. R. Wanless, Alfred H. Bell
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 Gerald C. Roberts, Shawnee, Okla.
 Charles E. Decker, Jack M. Copass, J. Lawrence Muir
 Sherril A. Shannon, Wichita, Kan.
 A. K. Wilhelm, Virgil B. Cole, Z. E. Stucky
 Charles Freeman Word, Abilene, Tex.
 K. B. Nowels, E. F. Boehms, Robert H. Cuyler

FOR TRANSFER TO ACTIVE MEMBERSHIP

- Neal Jesse Bingman, Midland, Tex.
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 Fay Coil, Midland, Tex.
 Maria Spencer, J. J. Russell, Jr., Wallace Gordon
 L. A. Douglas, San Antonio, Tex.
 Ed. W. Owen, Charles H. Row, H. H. Henderson
 Thomas John Fitzgerald, Bakersfield, Calif.
 H. W. Hoots, Rollin Eckis, Drexler Dana
 William Clayton Fritz, Midland, Tex.
 Ed. W. Owen, Joseph E. Morero, Russell C. Conkling
 Russell Barnes Kerbow, Pittsburgh, Pa.
 B. E. Thompson, C. D. Cordry, J. B. Lovejoy
 John Harold Regan, Caripito, Venezuela, S.A.
 J. L. Kalb, R. H. Sherman, James W. Hunter

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J. E. EATON*Consulting Geologist*

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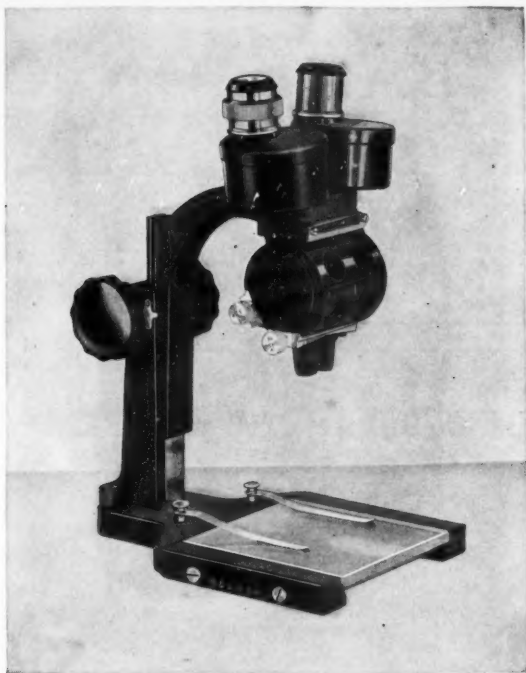
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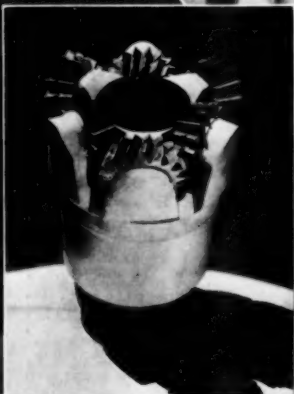
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